FINAL SUBMITTAL

ENERGY SURVEY OF

EISENHOWER ARMY MEDICAL CENTER
FORT GORDON

AUGUSTA, GEORGIA

VOLUME II

APPENDICES

CONTRACT NO. DACA01-94-D-0038

PREPARED FOR:

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U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

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DEPARTMENT OF THE ARMY
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A. SCOPE OF WORK AND MEETING MINUTES

APPENDIX A
for Delivery Order No. 5,

AN ENERGY SURVEY OF EISENHOWER ARMY MEDICAL CENTER,
FORT GORDON, GA

1. BRIEF DESCRIPTION OF WORK: The A-E shall:

1.1 Perform a complete energy audit of the entire Army Medical Center's (AMC) heating and cooling systems, lighting system, and other systems and areas as indicated in Annex A.

1.2 Perform a comprehensive analysis of all data collected during the audit.

1.3 Identify all Energy Conservation Opportunities (ECO's) including low cost/no cost ECO's and perform complete evaluations of each. Energy equipment replacement projects already underway, approved, or planned by the Medical Center staff will be factored into the evaluations.

1.4 Prepare programming documentation for all Federal Energy Management Program (FEMP) and/or Energy Conservation Improvement Program (ECIP) projects.

1.5 Prepare implementation documentation and instructions for those projects recommended for accomplishment by local forces.

1.6 List and prioritize all recommended ECO's.

1.7 Prepare a comprehensive report which will document the work accomplished, the results of the field investigation and engineering analysis, the conclusions, and recommendations.

2. SPECIFIC INSTRUCTIONS:

2.1 Audit. The audit shall consist of gathering data and inspecting the facility in the field.

2.1.1 Boiler plant, chilled water plant, and any other parts of the hospital connected to the boiler or chiller plant will be surveyed to determine the condition of existing equipment, efficiency of boilers, operational procedures, and adequacy of plant capacity. Lighting throughout the facility will be surveyed, and other systems and specific areas as listed in Annex A will be investigated to determine whether ECO's which meet Army criteria can be found.

2.1.2 Data collected during the audit shall be in sufficient detail to identify each air handling system and zone, areas served, supply, return, and exhaust air quantities, temperatures and relative humidities, chilled and condenser water flow rates, lighting levels, and similar data. Actual field measurements will be made to determine these factors. The facility as-built drawings will be used only as a starting point in developing the plan for surveying the facility but will be corrected if errors are discovered during the field investigation.

2.1.2.1 As a minimum the following data will be collected:

-- Building number, building age, number of floors, and gross area
-- Floor area, HVAC zoning, nonconditioned spaces, space utilization
-- Glass areas
-- Wall and roof surface areas and condition, type of construction, and "U" factors
-- Building drawings, equipment schedules, distribution layout, control diagrams, electrical schematics, lighting layout, fixture types, and lighting levels of major systems and areas
-- Name plate data of major energy related equipment and the condition of the equipment
-- Measurement of air flow rates, outside air quantities, exhaust rates, water flow rates, and other energy media quantities by zone or area as appropriate
-- Historical weather information for the greater Augusta area
-- Facility operating hours
-- System and equipment operating and control schedules
-- Control set points, chilled water temperatures, and freeze protection temperatures
-- Rooms, areas, or zones with special or critical requirements
-- Building occupancy and distribution of functions and personnel
-- Frequency of use of building access points
-- Unauthorized modifications to existing equipment or systems
-- Historical peak energy demands
-- Unit energy consumption
-- Utility rate schedules and previous twelve months utility billings
-- Energy sources
-- Boiler efficiency and water chemistry tests
-- Opportunities for maintenance improvements

2.2 <u>Analysis.</u> The analysis shall use computer modeling. The model used by the software program shall be able to integrate field survey data, weather data, occupancy schedules, building construction data, energy distribution systems and equipment data into a comprehensive model of the total facility. Load profiles shall be developed on an hour by hour basis. All output of the

modeling program shall be calibrated against past records and the model adjusted, where necessary, until historical record information can be repeated within an acceptable margin of error before proceeding to use the model to predict future loads, equipment performance, or results of energy improvement projects. The A-E shall use either the Army's BLAST program, DOE 2, Trane TRACE, or Carrier HAP for this purpose.

2.2.1 As a minimum the following information shall be output by the program:

-- Existing facility baseline energy usage
-- Peak heating and cooling loads
-- Comparison of equipment capacities with expected requirements
-- Energy usage by system - i.e., lighting, heating, cooling, etc.
-- Basis for evaluating ECO's
-- Theoretical facility baseline energy usage after each recommended improvement is made and after all improvements are made
-- Graphical presentations of the above information which will depict a complete heating and cooling consumption picture for the hospital both before and after each recommended energy improvement is made

2.2.2 The A-E shall develop a listing of each zone or area of the hospital as appropriate. The list shall include the air handling system serving the area, the existing supply, return and exhaust air quantities, temperaure and humidity setpoints, differential pressure readings and similar data required for the analysis. The current criteria requirements for supply, return and exhaust air quantities, temperature and humidity setpoints, etc. shall also be shown. The listing shall be in sufficient detail so that areas with potential energy savings from air balancing, incorporation of current criteria, control revisions and similar measures can be identified. The A-E shall be familiar with the latest Army hospital criteria and shall evaluate installed systems for possible energy saving opportunities which may be permitted by current criteria.

2.3 Identify all ECO's. All methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures and maintenance practices as well as the physical facilities. A list of energy conservation opportunities is included as Annex A to this scope. This list is not intended to be restrictive but only to assure that at least these opportunities are considered, discussed and documented in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for

elimination from further analysis. All potential ECO's which are not eliminated by preliminary consideration shall be thoroughly documented and evaluated as to technical and economic feasibility. The A-E shall provide all data and calculations needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be in an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers' catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

2.3.1 Energy Monitoring and Control System (EMCS). The A-E shall determine the feasibility of installing an EMCS to control the hospital heating and cooling systems from the existing EMCS control room and the particular pieces of equipment to be monitored and controlled. Any recommendations made shall specify equipment that is compatible with the installation's existing EMCS. The recommendation shall be in sufficient detail to define the system configuration, the approximate quantity and types of control instruments and sensors, and the data transnmission system. The control system functions, expected energy reduction, and monetary savings (including the manner in which these savings are to be achieved) shall be explained. EMCS evaluations shall consider but not be limited to the following features:

2.3.1.1 Start/Stop Programs
- Scheduling
- Duty cycling
- Load shedding for electrical demand limiting
- Start/stop optimization

2.3.1.2 Ventilation and Recirculation Programs
- Dry bulb economizer
- Outside air reduction

2.3.1.3 Temperature Reset Programs
- Space temperature night setback
- Reheat coil
- Hot and cold deck
- Chilled water
- Chiller selection
- Boiler selection

2.3.1.4 Labor Savings/Monitoring, provided the SIR is not affected to the extent of jeopardizing the project qualifying critieria.

2.4 Prepare programming documentation. All assumptions, formulas, input and output values, and the actual calculations used in generating project cost estimtes and savings will be included with each ECO. All energy conservation opportunities or projects

which the A-E has considered shall be included in one of the following categories and presented in the report as such:

2.4.1 <u>Federal Energy Management Program (FEMP) Projects.</u> Every attempt will be made to keep <u>all</u> projects within the Installation Commander's funding approval authorities applicable to the Operations and Maintenance, Army (OMA) account. These limitations are generally $300,000 for a project classified as construction and $1,000,000 for projects classified as maintenance <u>or</u> repair, as defined in reference 9.2 and modified by reference 9.10. There is a special source of OMA funding for energy savings type projects, the cost of which are estimated to fall below these limitations, on a one year cycle or less, if a project is properly justified. To be classified as an OMA Energy maintenance or repair project, the project must result in needed maintenance or repair to an existing facility or replace a failed or failing system or component and result in energy savings. If the project would replace a system or component that is considered failed or failing due solely to obsolete technolegy or inefficiency, the system or component to be replaced must have been in use for at least three years and the simple payback period must be ten years or less. So long as the work can be logically separated and identified, projects can be combined in one undertaking. Any recommended proect must have, as a minimum, a Savings to Investment Ratio (SIR) of 1.25 and a simple payback period of 10 years or less. The documentation required for each project is the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA (i.e., energy and non-energy savings calculations and cost estimate), the SIR, and the simple payback period. The documentation of these projects will be a part of the study report described below.

2.4.2 <u>Energy Conservation Investment Program (ECIP) Projects.</u> If a project cost estimate is greater than the limitations mentioned above, then the project becomes an ECIP project by definition. An ECIP project is one that proposes new construction or a retrofit of an existing facility for the purpose of conserving energy. In an ECIP project, savings may come from energy, demand, operations and maintenance, other factors, or a combination of the above. In addition to the cost threshhold, a project must also have an SIR greater than 1.25 and a simple payback period of less than ten years to meet the minimum criteria for ECIP projects. Where ECO's have been combined into one ECIP project, each discrete part must meet the SIR and simple payback criteria. Programming documentation shall consist of a DD Form 1391 and an LCCA summary sheet with necessary backup data to verify the numbers presented. An LCCA summary sheet shall be developed for each ECO and for the overall project when more than one ECO have been combined.

2.4.3 <u>Nonfeasible ECO's.</u> All ECO's which the A-E has considered but which are not feasible shall be documented in the report with reasons and justifications showing why they were

rejected. All ECO's which do not comply with current criteria for Army Medical Facilities will be classified as nonfeasible. Criteria include the Joint Commission on Accreditation of Hospitals (JCAH), Occupational Safety and Health Act (OSHA), and the National Fire Protection Association (NFPA) Life Safety Code.

2.5 Prepare implementation documentation and instructions for low cost/no cost projects. These are projects which the DPW can complete using his in-house work force. Minimum documentation will consist of a description of the project, a sketch of the location and the work required, a rationale for why the project is recommended, and a cost estimate. Other project documentation requirements may be added by the Fort Gordon Energy Coordinator (FGEC).

2.6 Prioritize ECO's. All recommended ECO's, including maintenance, operational, and low cost/no cost opportunities, as well as ECIP projects, shall be ranked in order of highest to lowest Savings to Investment Ratio (SIR).

2.7 Study report. The work accomplished shall be fully documented by a comprehensive report. While the cost of report production is certainly a consideration, the report submittals must be well organized and lend themselves to quick and easy review because the installation staff will have only limited time available for this. The A-E is expected to compile the information for the submittals in a logical sequence and must take great care to consider the reader's point of view. Spelling, grammar, and punctuation will be checked prior to making a submittal; and, for clarity, highly technical terms will be explained. Before making copies for each submittal, the report will be proofread and critiqued by an employee of the firm not familiar with the project to insure good readability. Just as important as any other part of the effort, the A-E must be concise in conveying the key information to the customer. Following these rules will help to insure that the A-E's credibility will not suffer and that his technical capabilities will not be questioned.

The interim submittal may be copied and bound in the most convenient and least expensive manner, so long as it meets the criteria above. The pre-final report will be organized, tabbed, copied, and bound in the exact manner which the A-E proposes to produce the final report. Review of both submittals will include comments on the report's organization and flow of thought. The final report will incorporate all earlier comments and, if the pre-final report is produced properly, will be produced by page for page replacement in or page addition to the pre-final report. A high quality 3-ring binder will be used to package the pre-final report.

For easy reading line length on the printed page is a consideration. It may be adviseable to use a two column format to

accomplish this. The pages of the original copy will be laser printed. Xeroxed copies on high quality paper are acceptable so long as there is essentially no discernible difference between them and the original. A title page will be inserted in a sleeve on the front cover and will contain a photograph descriptive of the report contents. The inside title page will also incorporate logos and credits to the A-E and the offices which have played a role in development of the study and report, particularly the installation. This will be followed by a table of contents. Each section, subsection, and appendix shall be separated by a thick paper divider tabbed with the section name and number. Each page will be numbered with a section number followed by a dash and a page number.

A separately bound Executive Summary of the study, giving a brief overview of the conclusions and recommendations using graphs, tables, and charts as much as possible, will be prepared as part of the final submittal. For clarity, color will be used, as necessary, in these graphic elements or any others that appear in the report.

The body of the report itself--i.e., that portion where the technical analysis, conclusions, and recommendations are developed--shall be organized in a logical manner and written simply enough for a person not an expert in the field to follow the line of reasoning for each project. All project documentation will be presented in this portion of the report. Appendices will include as a minimum the Scope of Work for this D.O., minutes of meetings, and survey forms. Any other appendices that the A-E thinks will assist in making the report better and more organized are also encouraged. If acronyms are used, there will be a list of each one used with a definition.

3. SERVICES AND MATERIALS: All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor (including that required to research installation records or databases to obtain all information needed to perform a thorough study), equipment, supervision, and travel necessary to complete the work and render the data required under this D.O. are to be included in the lump sum price.

4. GENERAL:

4.1 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study. The A-E is encouraged to use his specialized knowledge in this field to provide additional information which will help the installation justify energy improvement projects.

4.2 For the heating and cooling systems described above all methods of energy conservation which are reasonable and practical

shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All systems improvements that are considered during the study will be documented in the report, including those that are rejected because they are considered infeasible with reasons given for elimination. If, under another set of assumptions, an infeasible project will become feasible, then so state. For example, if using in-house labor to perform work would be less costly than using contract labor, and this change would result in meeting the SIR and payback criteria, then document this.

4.3 The "Energy Conservation Investment Program (ECIP) Guidance," described in a letter from DAIM-FDF-U, dated 10 Jan 1994, and any subsequent revisions establish criteria for ECIP projects and shall be used for performing the economic analyses associated with these projects. The software program, Life Cycle Cost in Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified in the ECIP guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer. The LCCID program is available from the BLAST Support Office at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61901 for a nominal fee. The telephone number is (217) 333-3977 or (800) 842-5278.

4.4 The A-E shall take great care to insure that the FGEC is kept apprised of the ongoing work, either directly or through periodic contact with his Savannah District project manager. The final recommended projects will be both technically and economically feasible and will be acceptable to the FGEC.

4.5 Public Disclosures. The A-E shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

4.6 Meetings. Meetings will be scheduled whenever requested by the A-E or the government's representative acting for the installation project manager for the resolution of questions or problems encountered in the performance of the work. These meetings, if necessary, will be in addition to the scheduled review meetings and presentations.

4.7 Site Visits, Inspections, and Investigations. The Contractor shall visit and inspect/investigate the site of the projects as necessary and required during the preparation and accomplishment of the work. Visits will be coordinated through the Savannah District project manager with the FGEC at least a week in advance. The A-E will determine whether any special security

clearances are required with the assistance of the FGEC.

4.8 All invoices or payment estimates (ENG Form 93) will be sent to the Savannah District project manager, who is identifed below in paragraph 5.4, for review and approval.

4.9 Records.

4.9.1 The A-E shall provide a record of all significnt conferences, meetings, discussions, verbal directions, telephone conversations, etc., with government personnel relative to this project in which the A-E has participated. These records shall be dated and shall identify the contract and D.O. number, participating personnel, subject discussed, and conclusions reached. The A-E shall forward by letter to the list of P.O.C.'s in paragraph 5 within ten calendar days of the event a reproducible copy of the records. These will also be included in the study report as an appendix.

4.9.2 The A-E should expect to provide the manpower needed for, and should base his fee proposal on, gathering all information himself required to complete the study. But, if the A-E faces a situation where he must request the installation's assistance, then he shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this D.O. The records shall be dated and shall identify the contract and D.O. number. The A-E shall forward to the Savannah District project manager within ten calendar days a reproducible copy of the record of request or receipt of material.

4.10 Briefings. The A-E and the Savannah District project manager shall conduct entry and exit interviews with the DPW, or his designated representative as instructed by the FGEC, before starting work at the installation and after completion of the study.

4.10.1 Entry. The entry interview shall describe the purpose of the study, the intended procedures for the survey, the schedule, names of personnel performing the field investigation and the A-E's project manager, support required by the A-E of the DPW staff, a description of the final products, and any other information the A-E wishes to communicate and shall be conducted prior to commencing work at the installation.

4.10.2 Exit. The exit interview shall describe the items surveyed, an assessment of the condition of existing systems, and the results and conclusions of the analysis.

5. PROJECT MANAGEMENT:

5.1 The A-E shall designate a project manager who will serve as the primary P.O.C. and liaison for work required under this D.O. Upon award of this D.O., the individual shall be immediately designated in writing. The A-E's designated project manager shall be approved by the Contracting Officer prior to commencement of work. The project manager will be responsible for coordination of work required under this D.O. The A-E's project manager shall submit monthly progress reports, typically in conjunction with pay requests, and shall telephonically update the Savannah District project manager on project events about every two weeks between pay requests. Immediately upon award of this D.O., the A-E's project manager will submit a project schedule substituting dates for calendar days, with an assumed 28 calendar day government review period after each submittal.

5.2 The Fort Gordon Energy Coordinator and installation project manager for this effort is Curt Oglesby, telephone number (706) 791-4243, FAX number (706) 791-7808. He will assist the A-E in obtaining information and establishing contacts necessary to accomplish the work required under this D.O.

5.3 The U.S. Training and Doctrine Command program manager is Blaney Hill, telephone number (804) 727-2374.

5.4 The U.S. Army Corps of Engineers, Savannah District, project manager is Rob Callahan, telephone number (912) 652-5246, FAX number (912) 652-5442.

5.5 The U.S. Army Corps of Engineers, Savannah District, Contracting Officers Representative is Tom Clarke, telephone number (912) 652-5364, FAX number (912) 652-5090.

5.6 The U.S. Army Corps of Engineers, Mobile District, is the Army's designated Technical Center of Expertise for the Energy Engineering Analysis Program. Mobile District's program manager is Tony Battaglia, telephone number (205) 690-2618, FAX number (205) 690-2424.

6. SUBMITTALS, PRESENTATIONS, AND REVIEWS:

6.1 Interim Report Submittal. An interim report, which will include all field notes, shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECO's. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan for the work remaining to complete the study. One copy of the interim report shall be submitted for review to the TRADOC and Mobile District P.O.C.'s. Two copies of the report shall be submitted to

the Fort Gordon and Savannah District P.O.C.'s. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECO's shall be included. The results of the ECO analyses shall be summarized by lists as follows:

6.1.1 All ECO's eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed above.

6.1.2 All ECO's which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by location or area as appropriate for the study.

6.1.3 The A-E shall make a presentation of the interim report at a review conference. Visual aids or other methods of presentation will be at the A-E's discretion to make understanding by those present easier.

6.2 Pre-final Report Submittal. The same number of copies shall be sent to the same offices as specified above for the interim report.

6.2.1 There will be a pre-final report review meeting at which comments on the pre-final submittal will be discussed.

6.3 Final Report. One copy each of the final submittal shall be sent to the TRADOC and Mobile District P.O.C.'s; two copies each shall be sent to the Savannah District P.O.C.; and three copies, along with the original, shall be sent to the Fort Gordon P.O.C. In addition one copy each of only the Executive Summary shall be sent to the Corps of Engineers, South Atlantic Division, P.O.C., the U.S. Army Logistics Evaluation Agency P.O.C., and to the HQUSACE P.O.C. listed below in paragraph 8.

6.4 Exit Briefing. There will be a formal presentation of the results of the study and analysis presented to a group of DPW and AMC personnel, and any others considered necessary, as designated by the FGEC.

7. PROJECT SCHEDULE:

Milestone	ED	Date	WEEKS
Entry interview and begin field investigation		NLT 30 calendar days after award of this D.O.	4
A-E submits interim report	112	NLT 112 calendar days after completion of field investigation	16

SW-11

	ED		EW
Govt Review		28 days	4
Interim submittal review meeting and presentation		NLT 14 calendar days after completion of government review of interim report	2
A-E submits pre-final report	240	NLT 56 calendar days after interim submittal review meeting	8
Govt. Review		28 days	4
Pre-final submittal review meeting		NLT 14 calendar days after completion of government review of pre-final report	2
A-E submits final report inserts	310	NLT 28 calendar days after completion ~~of government review o~~f pre-final report review meeting	4
Exit briefing	324	NLT 14 calendar days after submitting final report	2
TOTAL			46

8. POINTS OF CONTACT:

Commander
U.S. Army Signal Center and Fort Gordon
ATTN: ATZH-DIC (Mr. Curt Oglesby)
Fort Gordon, GA 30905-5000
Telephone: (706) 791-4243
FAX: (706) 791-7808

Commander
U.S. Training and Doctrine Command
ATTN: ATBO-GE (Mr. Blaney Hill)
Fort Monroe, VA 23651-5000
Telephone: (804) 727-2374

Savannah District, Corps of Engineers
ATTN: CESAS-PM-MR-2 (Mr. Rob Callahan)
100 W. Oglethorpe Avenue
P.O. Box 889
Savannah, GA 31402-0889
Telephone: (912) 652-5246
FAX: (912) 652-5442

Mobile District, Corps of Engineers
ATTN: CESAM-EN-DM (Mr. Tony Battaglia)
P.O. Box 2288
Mobile, AL 36628-0001
Telephone: (334) 690-2618
FAX: (334) 690-2424

9. REFERENCES:

9.1 Architect and Engineer Instructions, 9 Dec 91

9.2 AR 420-10, Management of Installation Directorates of Engineering and Housing, 2 Jul 87

9.3 AR 415-15 (DRAFT), Army Military Construction Program Development and Execution

9.4 Energy Conservation Investment Program (ECIP) Guidance, 10 Jan 94

9.5 TM 5-785, Engineering Weather Data

9.6 TM 5-800-4, Programming Cost Estimates for Military Construction, Feb 94

9.7 General Energy Conservation Opportunities

9.8 Required DD Form 1391 Data

9.9 AR 11-27, Army Energy Program, 14 Jul 89

9.10 TWX dated 111600Z Jul 94 from DAIM-FDF-B, subject: Future Change to AR 420-10

9.11 TM 5-815-2, Energy Monitoring and Control Systems (EMCS), Jan 91

9.12 HNDSP90-244-ED-ME, "EMCS Cost Estimating Guidelines"

9.13 EMCS related Corps of Engineers Guide Specifications as follows:

(a) CEGS 13810 - Energy Monitoring and Control System (EMCS) Large Configuration

(b) CEGS 13814 - Building Preparation for Energy Monitoring and Control Systems

(c) CEGS 13945 - Multi-Building Expansion of Energy Monitoring and Control Systems

(d) CEGS 16795 - Fiber Optics Data Transmission System

9.14 Joint Commission on Accreditation of Hospitals criteria

9.15 Occupational Safety and Health Act (OSHA) criteria

9.16 National Fire Protection Association (NFPA) Life Safety Code

9.17 TM 5-838-2, Army Health Facility Design Manual

9.18 ETL 1110-3-344, Interior Mechanical Design Conditions for Army and Air Force Medical Facilities

9.19 NCEL CR 82.030 Standardized EMCS Energy Savings Calculations

9.20 Latest Engineer Improvement Recommendation System bulletin for cost escalation

ANNEX A

ENERGY CONSERVATION OPPORTUNITIES

Heating, ventilation, and air conditioning

1. Shut off air handling units whenever possible
2. Reduce outside air intake when air must be heated or cooled before use.
3. Reduce volume of air circulated through air handling units.
4. Shut off or reduce speed of room fan coils.
5. Shut off or reduce stairwell heating.
6. Shut off unneeded circulating pumps.
7. Reduce humidification to minimum requirements.
8. Reduce condenser water temperature.
9. Cycle fans and pumps.
10. Reduce pumping flow.
11. Reset thermostats higher during cooling and lower during heating.
12. Repair and maintain steam lines and steam traps.
13. Use damper controls to shut off air to unoccupied areas.
14. Reset hot and cold deck temperatures based on areas with greatest need.
15. Raise chilled water temperature.
16. Shed loads during peak electrical use periods.
17. Use outside air for free cooling whenever possible. (Dry bulb economizers)
18. Reduce reheating of cooled air.
19. Recover heating or cooling with energy recovery units.
20. Reduce chilled water circulated during light cooling loads.
21. Install minimum sized motor to meet loads.
22. Replace hand valves with automatic controls.
23. Install variable air volume controls.
24. Insulate ducts and piping.
25. Eliminate simultaneous heating and cooling.
26. Install night setback controls.
27. Clean coils.
28. Maintain filters.
29. Repair and/or maintain air handling controls.
30. Multispeed/vairable speed cooling tower fans.
31. Use centrifugal chillers instead of absorption chillers.
32. Common manifolding of chillers.

Boiler plant

1. Reduce steam distribution pressure.
2. Shut off steam to laundry when not is use.
3. Increase boiler efficiency.
4. Repair, replace, or install condensate return system.
5. Insulate boiler and boiler piping.

6. Install economizer.
7. Install air preheater.
8. Check boiler water chemistry program.
9. Clean boiler tubes.
10. Blowdown controls.
11. Boiler and chiller control modifications.
12. Water treatment to prevent tube fouling.
13. Blowdown heat recovery.
14. Oxygen trim controls.

Lighting

1. Shut off lights when not needed.
2. Reduce lightning levels.
3. Revise cleaning schedules.
4. Convert to energy efficient systems.
5. Reflectors for fluorescent fixtures.
6. Separate switches to control lighting arrangements.
7. Analysis of effects of harmonics for electronic ballast system.

Building envelope

1. Reduce infiltration by caulking and weatherstripping.
2. Install insulated glass or double glazed windows.
3. Install roof insulation.
4. Install loading dock seals.
5. Install vestibules on entrances.
6. Reduce window heat gain by solar shading, screening, curtains, or blinds.
7. Install wall insulation.
8. Low emissivity windows.

Electrical equipment

1. Shut off elevators whenever possible.
2. Shut off pneumatic tube system whenever possible.
3. Install capacitors or synchronous motors to increase power factor.
4. Use emergency generator to reduce peak demand.
5. Shed or cycle electrical loads to reduce peak demand.
6. Convert to energy efficient motors.
7. Variable volume pumping.

Plumbing

1. Reduce domestic hot water temperature.
2. Repair and maintain hot water and steam piping insulation.

3. Install flow restrictors.
4. Install faucets which automatically shut off water flow.
5. Decentralize hot water heating.
6. Add pipe insulation.

Kitchen

1. Shut off range hood exhaust whenever possible.
2. Install high-efficiency steam control valves.
3. Shut off equipment and appliances whenever possible.
4. Install makeup air supply for exhaust.
5. Install heat reclamation system for exhaust heat.
6. Turn off lights in coolers.
7. Water heating heat pump.
8. Install energy efficient exhaust hoods.

Miscellaneous

1. Install computerized energy monitoring and control system.
2. Convert steam driven turbine to electric motor.
3. Occupancy sensors to control lighting or HVAC.
4. Use of natural gas cooling technology to reduce peak demand, such as
   -- Desiccant cooling
   -- Direct-fired, couble-effect absorption chiller.

CESAS-PM-MP 7 Sep 95

MEMORANDUM FOR RECORD

SUBJECT: Prenegotiation Conference for Energy Engineering Analysis Program (EEAP) project entitled Energy Survey of Eisenhower Army Medical Center (AMC), Fort Gordon, GA

1. The undersigned called the subject meeting to order on 31 Aug 1995 at 0800 in the Fort Gordon DPW conference room. Attendees at the meeting are shown on encl 1.

2. Following are the salient points from the ensuing discussion of the project Scope of Work:

a. There are many projects currently under development to make various imporvements at Eisenhower AMC. Several of these are energy related, but as well as Curt can tell from the information he's seen the energy related projects are essentially replacement in kind of different pieces of equipment. Little, if any, analysis has been performed to determine whether replacement in kind is the best engineered solution to the AMC's problems. What Reynolds, Smith, & Hills (RS&H) is instructed to do is obtain from Curt the list of projects that actually receives FY 95 funding by the end of September and perform their analysis factoring in the data from the new equipment as they put together their recommended or non-recommended Energy Conservation Opportunities (ECO's). Analysis of other ECO's, to include AMC projects not funded in FY 95 and energy related projects independently identified by RS&H, will undergo the standard type EEAP analysis that is normally performed on potential energy savings projects. Curt will then take the analyses performed on those AMC projects not funded in FY 95 that result in recommendations differing from what is already under development in the projects and try to convince the Eisenhower AMC staff to change the projects to ones with a better chance of saving energy.

b. Any recommended project(s) related to EMCS will have to be judiciously dealt with because there is a controversy between the Eisenhower AMC staff and the DPW staff about who should be in control. As a minimum, however, any recommeded EMCS project will include equipment that is compatible with existing equipment presently being used in the DPW installation EMCS control room.

c. There is some confusion among us all as to what the appropriate source documents for criteria are. I will try to sort this out, obtain copies of the various criteria documents, and insure that RS&H is sent the most recent version of each.

d. Carlos stated that Paul will be project manager for RS&H and that he will be project officer.

e. Curt stated that he has a CERL software program called REAP

that can assist in screening potential projects for those most likely to pay off under the energy criteria. He will send Paul a copy if he requests it.

f. The study of energy savings associated with lighting systems was added into the Scope of Work for the project with the caveat that harmonics associated with electronic ballasts must be carefully taken into consideration because of possible interference with other sensitive electronic equipment in the AMC.

g. Other systems and areas of the AMC were also added into the Scope of Work for study under this delivery order, and I have modified the Scope to reflect these changes.

3. Because of a schedule conflict, Curt had to attend another meeting, so we initially adjourned the meeting at about 0900. Carlos, Paul, and I then proceeded to Eisenhower AMC and were shown the various mechanical rooms in the AMC and the AMC energy plant by personnel who work for Bob Calhoun, the site maintenance manager for Johnson Controls. Our facility tour lasted about two hours.

4. We reconvened our meeting with Curt at about 1130, went over a few remaining points, and signed our Partnering Agreement (encl 2). I adjourned the meeting at 1230.

Robert A. Callahan

Robert A. Callahan
Project Manager

CONFERENCE PARTICIPANTS

Project Eisenhower AMC Energy Study	Date: 31 Aug 95
Base: Fort Gordon	Time: 0800
Fiscial Year	Local:
Line Item	Type: Pre-negotiation

Name	Position	Organization	Office Sym.	Telephone
1. Rob Callahan	Project Manager	Corps of Engineers Savannah District	CESAS-PM-MP	DSN 971-6330, ext. 5246 (912) 652-5246
2. CARLOS WARREN	PROJ. OFFICER	RS&H		(904) 279-2275
3. PAUL Hutchins	Proj. Manager	RS&H		(904) 279-2277
4. Curt Oglesby	Energy Coordinator	Fort Gordon, DPW	ATZH-DIC	(706) 791-8283
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PARTNERING AGREEMENT
FOR AN ENERGY SURVEY OF EISENHOWER HOSPITAL
AT FORT GORDON, GA

I. We, the FORT GORDON EISENHOWER HOSPITAL ENERGY STUDY TEAM, are committed to a positive utilization of partnering in the conduct of this project. We believe that through partnering we will be able to provide a quality and functional product completed on time and within budget.

II. We are committed to open communication, joint problem solving, and team work to accomplish the following goals:

- A satisfied customer with quality products

- Successful project completion which includes:
  -- Meeting user requirements
  -- Following user and other pertinent guidance
  -- Providing the products within the budget
  -- Completion on or ahead of schedule

- Total team approach resulting in outstanding team performance.

III. Our goals will be achieved through a commitment to teamwork and partnering characterized by mutual trust, responsiveness, flexibility, and open communication. To accomplish these goals, we, the FORT GORDON EISENHOWER HOSPITAL ENERGY STUDY TEAM, commit to project decision making at the lowest possible level within the team.

IV. The schedule for completion of this project is included in the Description of Work. Detailed customer expectations, if any, are attached. Any necessary changes to the schedule or the Description of Work will be coordinated with all signers by the Savannah District Project Manager.

Curtis D. Oglesby FORT GORDON DPW by RAC	EISENHOWER HOSPITAL
[signature] REYNOLDS, SMITH AND HILLS	Robert A. Callahan U.S. ARMY CORPS OF ENGINEERS

MEETING NOTES

Copies To:	Participants C. Warren	Date:	Nov. 2, 1995
Project:	Energy Audit Eisenhower Army Medical Center Energy Audit Entrance Interview	Project No.:	6941331005
Meeting Place:	Ft. Gordon PWC	Meeting Date:	10/27/95

Participants:	Col. Plank	Director PWC
	Curt Oglesby	Energy Manager
	Jack Keath	Eisenhower AMC Facility Manager
	Rob Callahan	Savannah District COE Project Mgr.
	Paul Hutchins	RS&H Project Manager

Following are the Minutes of the Meeting:
Please review and advise of any changes.

Dr. Paul Hutchins distributed to all attendees an Entrance Interview handout. It contained the current project schedule, a list of the final work products, a list of the field investigation team from RS&H and the list of Energy Conservation Opportunities from the Scope of Work. Dr. Hutchins discussed the various topics with the group.

Colonel Plank wanted to be sure future equipment loads are accounted for in the study. He also intends to use the results of this study and apply them to other parts of the installation. Colonel Plank stated that the recommendations should be simple to use and maintain.

Dr. Paul Hutchins also discussed some of the findings of the initial survey. There are T8 lamps and electronic ballasts on the 10th floor of the hospital and in a couple other isolated areas. The HVAC controls are operating correctly for the most part. However, the air side economizer effectiveness is greatly reduced due to the poor condition of the control dampers. Three cooling towers (Nos. 1, 3 and the generator tower) and several condenser pumps are obviously in poor condition and are being replaced in the project that was funded at the end of FY 95.

REYNOLDS, SMITH AND HILLS
Architects•Engineers•Planners, Inc.
P.O. Box 4850
Jacksonville, Florida 32201
(904/296-2000)

By: Paul Hutchins
Paul F. Hutchins, PE

Additional projects funded include replacement of two centrifugal chillers, addition of variable speed drives on chilled water pumps, removal of boiler economizer and replacement of boiler condensate pumps. Another project, which should be funded in the first half of FY 96, replaces the HVAC controls with DDC types, replaces pneumatic actuators and control dampers and installs a comprehensive Energy Management Control System for the hospital.

Curt Oglesby presented names and telephone number of the electricity and natural gas utilities.

/gk

B. ENERGY DATA AND UTILITY RATE INFORMATION

EISENHOWER ARMY MEDICAL CENTER ENERGY AUDIT
FORT GORDON
ENERGY USE DATA
Filename: ENDATA.WK4

		Electricity						Natural Gas			
FY	Month	Demand (kW)	Energy (kWh)	Cost	Avg. Cost (c/kWH)	Load Factor	Energy (MBtu)	Energy (Mcf)	Energy (MBtu)	Cost	Price (c/therm)
93	Oct	3625	2,178,000	$88,100	4.04	0.83	7,434	7,469	7,701	21,562	28.00
	Nov	3920	1,825,200	$81,000	4.44	0.64	6,229	9,131	9,414	28,054	29.80
	Dec	3348	1,951,200	$83,500	4.28	0.80	6,659	11,745	12,109	40,808	33.70
	Jan	3557	1,944,000	$83,300	4.28	0.75	6,635	10,457	10,781	35,686	33.10
	Feb	3463	1,699,200	$78,300	4.61	0.67	5,799	9,157	9,441	34,554	36.60
	Mar	3532	1,839,600	$81,200	4.41	0.72	6,279	8,442	8,704	31,072	35.70
	Apr	3481	2,073,600	$86,000	4.15	0.82	7,077	7,877	8,121	23,795	29.30
	May	3889	1,980,000	$84,100	4.25	0.70	6,758	5,985	6,171	17,216	27.90
	Jun	4036	2,307,600	$95,000	4.12	0.79	7,876	5,796	5,976	15,656	26.20
	Jul	4190	2,448,000	$97,900	4.00	0.80	8,355	3,804	3,922	11,177	28.50
	Aug	4176	2,689,200	$103,500	3.85	0.89	9,178	4,287	4,420	12,022	27.20
	Sep	4133	2,516,400	$100,500	3.99	0.84	8,588	3,917	4,038	9,733	24.10
94	Oct	3985	2,088,000	$86,400	4.14	0.72	7,126	3,917	4,038	9,733	24.10
	Nov	3917	1,969,200	$83,900	4.26	0.69	6,721	7,765	8,006	21,535	26.90
	Dec	3402	1,731,600	$81,800	4.72	0.70	5,910	8,124	8,376	22,531	26.90
	Jan	3301	1,868,400	$84,900	4.54	0.78	6,377	5,897	6,080	15,868	26.10
	Feb	3524	1,677,600	$80,600	4.80	0.65	5,726	7,069	7,288	17,929	24.60
	Mar	3564	1,940,400	$86,500	4.46	0.75	6,623	8,364	8,623	20,955	24.30
	Apr	3877	2,095,200	$89,900	4.29	0.74	7,151	6,032	6,219	15,050	24.20
	May	3924	2,055,600	$89,000	4.33	0.72	7,016	5,296	5,460	13,705	25.10
	Jun	3974	2,365,200	$99,900	4.22	0.82	8,072	3,630	3,743	9,431	25.20
	Jul	4093	2,394,000	$101,000	4.22	0.80	8,171	3,415	3,521	8,168	23.20
	Aug	4075	2,696,400	$108,000	4.01	0.91	9,203	4,041	4,166	9,124	21.90
	Sep	4201	2,318,400	$99,400	4.29	0.76	7,913	4,184	4,314	10,353	24.00
95	Oct	3697	2,127,600	$90,600	4.26	0.79	7,261	5,420	5,588	13,858	24.80
	Nov	3730	1,882,800	$85,300	4.53	0.69	6,426	6,738	6,947	18,270	26.30
	Dec	3319	1,674,000	$80,900	4.83	0.69	5,713	61	63	170	27.00
	Jan	3308	1,886,400	$85,800	4.55	0.78	6,438	9,515	9,810	26,487	27.00
	Feb	3312	1,501,200	$76,800	5.12	0.62	5,124	8,393	8,653	23,364	27.00
	Mar	3380	1,980,000	$87,900	4.44	0.81	6,758	7,448	7,679	20,733	27.00
	Apr	3388	1,778,400	$83,500	4.70	0.72	6,070	6,401	6,599	17,818	27.00
	May	3884	2,091,600	$90,300	4.32	0.74	7,139	5,818	5,998	16,196	27.00
	Jun	3694	2,192,400	$95,900	4.37	0.82	7,483	4,567	4,709	12,713	27.00
	Jul	4021	2,412,000	$101,200	4.20	0.82	8,232	3,903	4,024	10,865	27.00
	Aug	4101	2,509,200	$104,000	4.14	0.84	8,564	4,171	4,300	11,611	27.00
	Sep	4010	2,260,800	$98,100	4.34	0.78	7,716	5,165	5,325	14,378	27.00
Totals	FY93	4190	25,452,000	$1,062,400	4.17	0.77	86,868	88,067	90,797	$281,334	30.98
	FY94	4201	25,200,000	$1,091,300	4.33	0.75	86,008	67,734	69,834	$174,382	24.97
	FY95	4101	24,296,400	$1,080,300	4.45	0.76	82,924	67,600	69,696	$186,462	26.75
	CY94	4201	25,095,600	$1,096,000	4.37	0.76	85,651	60,147	62,012	$152,882	24.65

Fy95 Summary	Use	Cost
Electricity	82,924	$1,080,300
Natural Gas	69,696	$186,462
Total	152,619	$1,266,762

FY 93

	OCT 92	NOV 92	DEC 92	JAN 93	FEB 93	MAR 93	APR 93	MAY 93	JUN 93	JUL 93	AUG 93	SEP 93	FY93 TOTAL
EAMC													
KWH	2,178,000	1,825,200	1,951,200	1,944,000	1,699,200	1,839,600	2,073,600	1,980,000	2,307,600	2,448,000	2,689,200	2,516,400	25,452,000
KW	3,625	3,920	3,348	3,557	3,463	3,532	3,481	3,899	4,036	4,190	4,176	4,133	4,190
COST	$88,069.22	$80,975.44	$83,535.81	$83,325.66	$78,301.35	$81,324.31	$86,009.58	$84,126.62	$94,957.02	$97,874.34	$103,471.54	$100,547.68	$1,062,518.57

FY 94

	OCT 93	NOV 93	DEC 93	JAN 94	FEB 94	MAR 94	APR 94	MAY 94	JUN 94	JUL 94	AUG 94	SEP 94	FY94 TOTAL
EAMC													
KWH	2,088,000	1,969,200	1,731,600	1,868,400	1,677,600	1,940,400	2,095,200	2,055,600	2,365,200	2,394,000	2,696,400	2,318,400	25,200,000
KW	3,985	3,917	3,402	3,301	3,524	3,564	3,877	3,924	3,974	4,093	4,075	4,201	
COST	$86,352.61	$83,913.47	$81,834.02	$84,861.01	$80,541.46	$86,480.52	$89,867.68	$88,993.36	$99,934.98	$100,966.44	$107,969.74	$99,399.54	$1,091,114.83

FY 95

	OCT 94	NOV 94	DEC 94	JAN 95	FEB 95	MAR 95	APR 95	MAY 95	JUN 95	JUL 95	AUG 95	SEP 95	FY95 TOTAL
EAMC													
KWH	2,127,600	1,882,800	1,674,000	1,886,400	1,501,200	1,980,000	1,778,400	2,091,600	2,192,400	2,412,000	2,509,200	2,260,800	24,296,400
KW	3,697	3,730	3,319	3,308	3,312	3,380	3,388	3,884	3,694	4,021	4,101	4,010	
COST	$90,566.33	$85,301.91	$80,939.37	$85,788.44	$76,790.53	$87,863.95	$83,495.53	$90,348.52	$95,865.97	$101,165.26	$104,001.94	$98,148.67	$1,080,276.42

ED-2

Bldg 310

FY 93		MCF
Oct 92	-	7469
Nov 92	-	9131
Dec 92	-	11745
Jan 93	-	10457
Feb 93	-	9157
Mar 93	-	8442
Apr 93	-	7877
May 93	-	5985
Jun 93	-	5796
Jul 93	-	3804
Aug 93	-	4287
Sep 93	-	3917

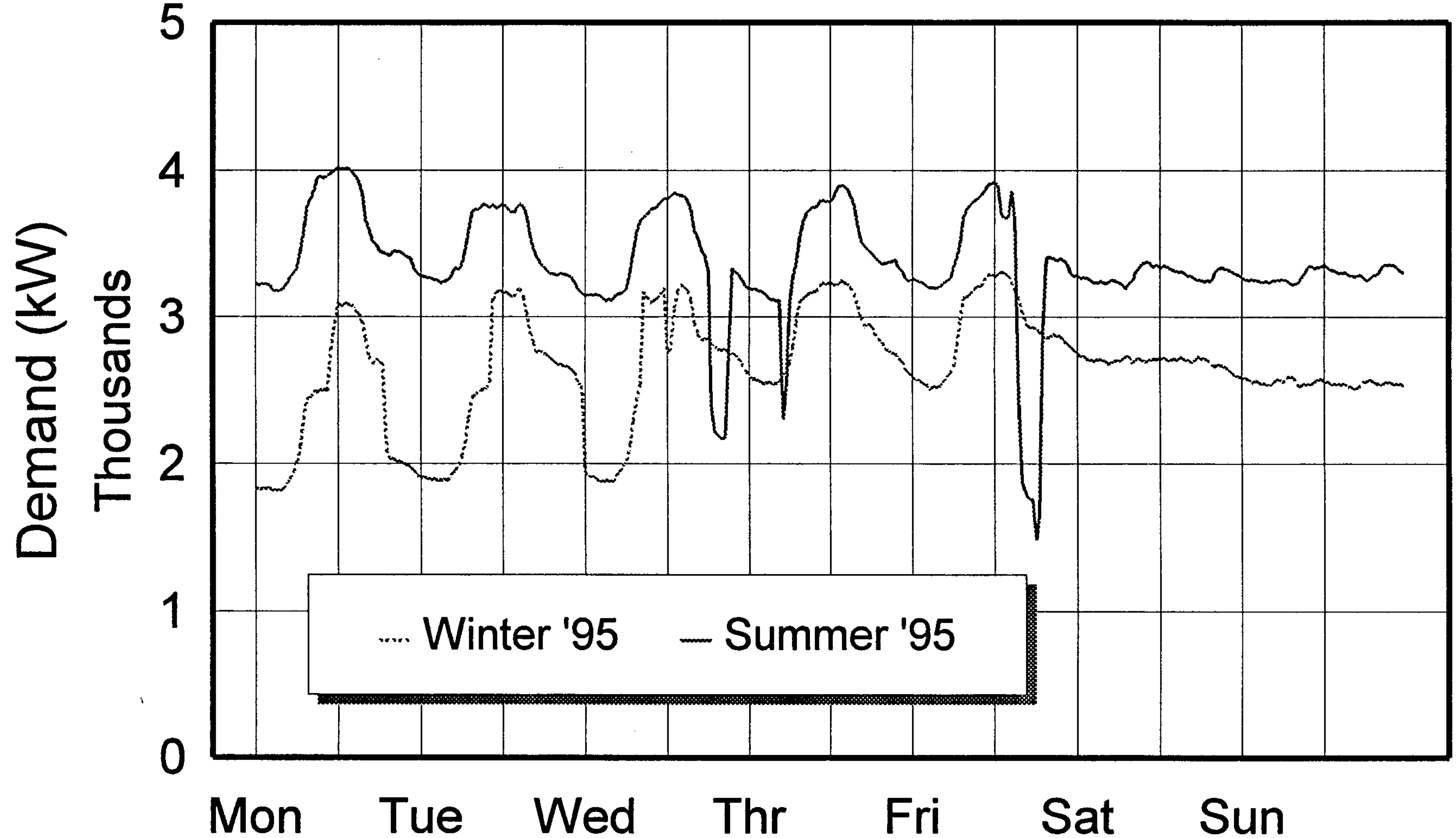
FY 94		MCF
Oct 93	-	3917
Nov 93	-	7765
Dec 93	-	8124
Jan 94	-	5897
Feb 94	-	7069
Mar 94	-	8364
Apr 94	-	6032
May 94	-	5296
Jun 94	-	3630
Jul 94	-	3415
Aug 94	-	4041
Sep 94	-	4184

FY 95		MCF
Oct 94	-	5420
Nov 94	-	6738
Dec 94	-	61
Jan 95	-	9575
Feb 95	-	8393
Mar 95	-	7448
Apr 95	-	6401
May 95	-	5818
Jun 95	-	4567
Jul 95	-	3903
Aug 95	-	4171
Sep 95	-	5765

ED-3

Eisenhower Army Medical Center

Historical Energy Use - Electricity



Eisenhower Army Medical Center
Fort Gordon Augusta, GA
Electricity Rate Analysis
Filename: ELRATE.WK4 INCREMENTAL CHARGES CALCULATION

12/01/95

Winter - May '95

	Billing		Actual	
Energy use:	2,091,600	kWh	2,091,600	kWh
Billing demand:	2,960	kW	3,884	kW
Load Factor:	0.98		0.75	

PL Charges (includes demand and energy in structure):

Tier	kWh	LF	Rate	(c/kWh)	Totals	kWh%
1	3,000	0.00	11.05+1.51	12.56	$377	0.1%
2	7,000	0.00	10.05+1.51	11.56	$809	0.3%
3	190,000	0.07	8.6+1.51	10.11	$19,209	9.1%
4	392,000	0.21	6.67+1.51	8.18	$32,066	18.7%
5	592,000	0.42	1.138+1.51	2.65	$15,676	28.3%
6	592,000	0.64	0.900+1.51	2.41	$14,267	28.3%
7	315,600	0.75	0.650+1.51	2.16	$6,817	15.1%
	2,091,600			4.27	$89,221	100.0%

Summer - September '95

	Billing		Actual	
Energy use:	2,018,407	kWh	2,260,800	kWh
Billing demand:	2,960	kW	4,010	kW
Load Factor:	0.98		0.81	

PL Charges (includes demand and energy in structure):

	Tier	kWh	LF	Rate	(c/kWh)	Totals	kWh%
	1	3,000	0.00	11.05+1.51	12.56	$377	0.1%
	2	7,000	0.00	10.05+1.51	11.56	$809	0.3%
	3	190,000	0.07	8.6+1.51	10.11	$19,209	8.4%
	4	392,000	0.21	6.67+1.51	8.18	$32,066	17.3%
	5	592,000	0.41	1.138+1.51	2.65	$15,676	26.2%
	6	592,000	0.62	0.900+1.51	2.41	$14,267	26.2%
	7	242,407	0.70	0.650+1.51	2.16	$5,236	10.7%
PL Total		2,018,407			4.34	$87,640	89.3%
SE Energy		242,393	0.78	1.97+1.51	3.48	$8,435	10.7%
Total Energy		2,260,800				$96,075	100.0%

	kW	$/kW	Totals
SE Demand	1050	0.80	$840
Total Charges		4.29	$96,915

If the load factor drops below 64% during the winter months, the incremental rate will increase to 2.4 c/kWh. Historically, this usually occurs only one month each year, February. Therefore the incremental rate for winter months will be the average of the last two tiers, which is 2.16 c kWh.
If the load factor drops below 70% during the summer months, the incremental rate will decrease to 2.2 c/kWh. Since the summer load factors are usually around 80%, this is unlikely to happen. Therefore, the incremental rate for the four summer months is 3.5 c/kWh.

The incremental energy rates are:

June - September	3.5 c/kWh.	October - May	2.2 c/kWh.

Average = (2.2 * 8 + 3.5 * 4) / 12 = 2.6 c/kWh

SEPTEMBER 1995

VERIFICATION OF BILLING FOR SUBSTATION #2 (EAMC) - SUMMER (MAY THRU SEP)
METERED 2,260,800 SERVICE PERIOD: 08-24-95 TO 09-22-95

PL-7 BILLING DATA:		METER READING DATA:		PRESENT:	39272
				PREVIOUS:	38644
PL-7 KWH:	2,018,407			CONSTANT	3600
ACTUAL KW -		ACTUAL RKVA -		METERED	2,260,800
ON-PEAK:	4,010	ON-PEAK:	3,147		
OFF-PEAK:	3,618	OFF-PEAK:	2,966		
BILLING K	2,960	EXCESS:	1,810		

BASE CHARGE:		$16.75	
ALL KWH NOT GREATER THAN 200 HRS TIMES BILLING DEMAND:			
FIRST 3,000 KWH @	$0.1105 /KWH	$331.50	
NEXT 7,000 KWH @	$0.1005 /KWH	$703.50	
NEXT 190,000 KWH @	$0.0860 /KWH	$16,340.00	
OVER 200,000 KWH @	$0.0667 /KWH	$26,146.40	
ALL KWH IN EXCESS OF 200 HRS AND NOT GREATER THAN 400 HOURS			
TIMES THE BILLING DEMAND	$0.01138 /KWH	$6,736.96	
ALL KWH IN EXCESS OF 400 HRS AND NOT GREATER THAN 600 HOURS			
TIMES THE BILLING DEMAND	$0.00900 /KWH	$5,328.00	
ALL KWH IN EXCESS OF 600 HRS TIMES BILLING DEMAND:			
(@	$0.00650 /KWH)	$1,575.65	
PL BASE REVENUE:			$57,178.76
EXCESS R $0.27 /EXCESS			$488.70
TOTAL PL REVENUE			$57,667.46

SE BILLING DATA

LOAD FACTOR:	81.0%	SE HOURS:
SE KW: (ON-PEAK):	1,050	285
SE KWH: (ON-PEAK):	242,393	
SE KW: (OFF-PEAK):	0	0
SE KWH: (OFF-PEAK):	0	
SE KWH TOTAL:	242,393	
AVAILABILITY FACTOR (EX. 0.944):	1.000	

SE REVENUE:

SE KWH (ON-PEAK) @	$0.0197 /KWH:		$4,775.14
SE KWH (OFF-PEAK) @	$0.0127 /KWH:		$0.00
SE DEMAND * AVAILABILITY *	$0.80 /KW, JUN THRU SEP:		$840.00
TOTAL SE REVENUE			$5,615.14
SUBTOTAL ADJUSTED BILLING (PL-8 & SE-5):			$63,282.60
DSO DB:		0.934350%	$591.28
FCR (KWH 0.015097 /KWH):			$34,131.30
SUBTOTALED BILLING (PL-8 & SE-5):			$98,005.18
ECONOMY CREDIT ADJUSTMENT:		0.011750%	$11.52
ADMINISTRATIVE CHARGE:			$155.00
TOTAL ADJUSTED BILLING (PL-8 & SE-5)			$98,148.66

UR-2

12/08/95

ELECTRICAL POWER CHARGES CALCULATION SPREADSHEET FOR
EISENHOWER ARMY MEDICAL CENTER - SUBSTATION #2

THIS SPREADSHEET WILL CALCULATE THE COSTS OF ELECTRICITY PURCHASED FROM POWER CO BASED ON THE PL-7 RATE (OCT THRU MAY) AND THE PL-7 RATE WITH SE-5 RIDER (JUN THRU SEP).

1. THE CALCULATION FOR OCT THRU APR BASED ON THE PL-7 RATE BEGINS AT CELL AA21. THE SHORT-CUT CALCULATION BEGINS AT CELL AI21.

2. THE CALCULATION FOR MAY THRU SEP BEGINS AT CELL AA61

MAY 1995

VERIFICATION OF BILLING FOR SUBSTATION #2 (EAMC) - WINTER (OCT THRU MAY)
METERED 2,091,600 SERVICE PERIOD: 04-24-95 TO 05-24-95

PL BILLING DATA:		METER READING DATA:		PRESENT:	36668
				PREVIOUS:	36087
PL KWH:	2,091,600			CONSTAN	3600
ACTUAL KW -		ACTUAL RKVA -		METERED	2,091,600
ON-PEAK:	3,884	ON-PEAK:	2,879		
OFF-PEAK:	2,669	OFF-PEAK:	2,669		
BILLING K	2,960	EXCESS:	1,584		

BASE CHARGE:		$16.75	
ALL KWH NOT GREATER THAN 200 HRS TIMES BILLING DEMAND:			
FIRST 3,000 KWH @	$0.1105 /KWH	$331.50	
NEXT 7,000 KWH @	$0.1005 /KWH	$703.50	
NEXT 190,000 KWH @	$0.0860 /KWH	$16,340.00	
OVER 200,000 KWH @	$0.0667 /KWH	$26,146.40	
ALL KWH IN EXCESS OF 200 HRS AND NOT GREATER THAN 400 HOURS			
TIMES THE BILLING DEMAND	$0.01138 /KWH	$6,736.96	
ALL KWH IN EXCESS OF 400 HRS AND NOT GREATER THAN 600 HOURS			
TIMES THE BILLING DEMAND	$0.00900 /KWH	$5,328.00	
ALL KWH IN EXCESS OF 600 HRS TIMES BILLING DEMAND:			
(@	$0.00650 /KWH)	$2,051.40	
PL BASE REVENUE:			$57,654.51
EXCESS R $0.27 /EXCESS:			$427.68
DSO CHARGE		0.934350%	$542.69
FCR (PL K 0.015097 /KWH):			$31,576.89
TOTAL PL REVENUE			$90,201.77
ECONOMY CREDIT ADJUSTMENT:		0.009150%	$8.25
ADJUSTED PL REVENUE			$90,193.52
ADMINISTRATIVE CHARGE:			$155.00
TOTAL ADJUSTED BILLING			$90,348.52

UR-3

RS&H®

Telephone Call Confirmation

Project Number ______

(706) 823-4532

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 11/2/95

Conversed with Michael Richardson of Georgia Power Co

Regarding Ft. Gordon Electricity Rates & Rebates

The Ft. Gordon hospital is on a combination rate
PLL2 - Power & Light - Large and
SE7 - Supplemental Energy
The SE Rate calls for the hospital to reduce its
demand ('94 peak = 4201 kw, '95 peak = 4104 kw)
to the billing demand of 2960 kw. They have
done this for 8 yrs with no problem. Typically
30-40 hours is required per year during summer.
Last year was high, ~76 hrs. Peak periods are
7AM to 10PM M-F Jun - Sep.
The is an Interruptible ~~Servi~~ Service rider available.
It currently pays $45/kw of demand reduced
(probably will be reduced to $25/kw by Dec '95).
There are 4hrs/yr forgiven. After that you pay
$3.50/kw ~~of~~ over the billing demand (2960 kw).

Distribution:

UR-4

RS&H®

Telephone Call Confirmation

Project Number ______

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 11/2/95

Conversed with Mike Richardson Of ______

Regarding ______

Since '91 the IS customers have only been asked to reduce demand in one year - ~~93~~ 95 for about 20 hrs. These overlapped the SE hours except for ½ hour. IS customers are called after SE customers. Must sign 3 yr agreement and give 3 yrs advance notice.

Real Time Pricing is also available, but utility analysis has shown < 1% savings over SE rate

SE structure has very low marginal energy costs thereby making energy conservation tough to justify.

MR will send rate info.

Distribution:

UR-5

RS&H®

Telephone Call Confirmation

Project Number ____________

Local ______ L.D. ✓ Placed ✓ Rec'd ✓ Date 12/8/95

Conversed with Michael Richardson Of Georgia Power

Regarding Ft. Gordon Electricity Rates.

RTP - for kW exceeding SE contracted amount only
(or current max for non-SE customers)
- Basically replaces SE portion of bill.
- All kwh purchased above contracted ~~amount~~ amount
(2960 kW for the hospital) is billed at rates
that vary for each hour of the day. The hourly
rates are given to the customer each day. The
amounts purchased ~~are~~ or replaced by curtailment
of loads or operation of on-site generation is the decision
of the customer.
- Based on operation of the generators for typical
curtailment hours ~~each~~ (~25 hrs/yr) the RTP structure
shows a small savings over SE. However, additional
hours of use can produce larger savings. Also
if ~~you~~ the hospital reduces its demand below the contracted
rate, it ~~can~~ gets a credit at the RTP price.

Distribution:

UR-6

continued

RS&H®

Telephone Call Confirmation

Project Number ______

Local ______ L.D. ______ Placed ______ Rec'd ______ Date 12/8/95

Conversed with M.R. Of Georgia Power

Regarding ______

- The RTP contract is for five years, but the customer is only obligated for one year.

M.R. will send additional info. on RTP analysis he had done in the past for Ft. Gordon

- Existing rate -

The PL rate, which includes demand and energy charges, is applied only to kWh usage under the contracted demand of 2960 kW. SE rate is charged for those hours ~~above~~ of use above 2960, during the summer months. Therefore, the marginal rate during ~~summer~~ - winter months is 2.16¢/kWh (0.65 + 1.51) and 3.48¢/kWh (1.97+1.51) during summer months (June - Sept)

Distribution:

GEORGIA POWER COMPANY

Power and Light

Large

SCHEDULE "PLL-2"

AVAILABILITY:

Throughout the Company's service area from existing lines of adequate capacity.

APPLICABILITY:

To all electric service of one standard voltage required on the customer's premises, delivered at one point and metered at or compensated to that voltage for any customer with a demand, as determined under the Special Applicability Provisions, of 500 kW or greater.

TYPE OF SERVICE:

Single or three phase, 60 hertz, at a standard voltage.

MONTHLY RATE - Energy Charge Including Demand Charge:

Base Charge $16.75

All consumption (kWh) not greater than 200 hours times the billing demand:

First 3,000 kWh	@	11.050¢ per kWh
Next 7,000 kWh	@	10.050¢ per kWh
Next 190,000 kWh	@	8.600¢ per kWh
Over 200,000 kWh	@	6.670¢ per kWh
All consumption (kWh) in excess of 200 hours and not greater than 400 hours times the billing demand	@	1.138¢ per kWh
All consumption (kWh) in excess of 400 hours and not greater than 600 hours times the billing demand	@	0.900¢ per kWh
All consumption (kWh) in excess of 600 hours times the billing demand	@	0.650¢ per kWh

Minimum Monthly Bill:

A. $16.75 Base Charge plus $8.00 per kW of billing demand, plus excess kVAR charges and Fuel Cost Recovery as applied to the current month kWh.

B. Metered Outdoor Lighting: The lessor of (1) that determined from paragraph "A" above, or (2) $39.70 per meter plus Fuel Cost Recovery for metered outdoor lighting installations, provided service is limited to the lighting equipment itself and such incidental load as may be required to operate coincidentally with the lighting equipment.

FUEL COST RECOVERY:

The amount calculated at the above rate will be increased under the provisions of the Company's effective Fuel Cost Recovery Schedule, including any applicable adjustments.

DETERMINATION OF BILLING DEMAND:

The Billing Demand shall be based on the highest 30-minute kW measurement during the current month and the preceding eleven (11) months.

For the billing months of June through September, the Billing Demand shall be the greatest of:
(1) The current actual demand, or,
(2) Ninety-Five percent (95%) of the highest actual demand occurring in any previous applicable summer month (June through September), or,
(3) Sixty percent (60%) of the highest actual demand occurring in any previous applicable winter month (October through May).

UR-8

DETERMINATION OF BILLING DEMAND: (Continued)

For the billing months of October through May, the Billing Demand shall be the greater of:
(1) Ninety-Five percent (95%) of the highest summer month (June through September), or,
(2) Sixty percent (60%) of the highest winter month (October through May), including the current month.

In no case shall the Billing Demand be less than the greatest of:
(1) The contract minimum, or,
(2) Fifty percent (50%) of the total contract capacity, or,
(3) 500 kW.

DETERMINATION OF REACTIVE DEMAND:

Where there is an indication of a power factor of less than 95% lagging, the Company may at its option, install metering equipment to measure Reactive Demand. The Reactive Demand shall be the highest 30-minute kVAR measured during the month. The Excess Reactive Demand shall be kVAR which is in excess of one-third of the measured actual kW in the current month. The Company will bill excess kVAR at the rate of $0.27 per excess kVAR.

SPECIAL APPLICABILITY:

Limitation of Service

Service will be provided hereunder for those customers having a calculated demand of 500 kW or greater where that calculation is the greater of:
(1) Applying Sixty percent (60%) to the current or previous 11 months winter or off-peak demands, or,
(2) Applying Ninety-Five percent (95%) to the current or previous 11 months summer or on-peak demands.

For customers on the Off-Peak (OP) and Variable Off-Peak (VOP) riders the demand shall be based on the percentages as stated in the riders.

Construction Service

Construction power shall be considered as a part of permanent service and will be provided in accordance with the Applicability section of this schedule. The Company will obtain a payment in advance for each metering point to be served in the amount currently on file with the Georgia Public Service Commission.

TERM OF CONTRACT:

Service hereunder shall be for a period of not less than five years.

REVENUE ADJUSTMENT:

The bill calculated at the above rate is subject to change in such an amount as may be determined under the provisions of the Company's Revenue Adjustment Rider, Schedule "RA-1", as approved by the Georgia Public Service Commission or as may be later amended.

Service hereunder subject to Rules and Regulations for Electric Service on file with the Georgia Public Service Commission.

GEORGIA POWER COMPANY

Supplemental Energy

SCHEDULE "SE-7"

AVAILABILITY:

Throughout the Company's service area from existing lines of adequate capacity.

APPLICABILITY:

This schedule applies to the Medium Power and Light rate, the Large Power and Light rate, the High Load Factor rate, and the Governmental rate, in conjunction with either the Company's Off-Peak Service Rider or Variable Off-Peak Service Rider conditional to the customer being able to demonstrate and maintain a peak 30-minute demand not less than 1,000 kW each month and an annual load factor not less than thirty-five percent (35%). The initial load factor shall be based on the month's load factor in which normal operation occurs or on the annual load factor once twelve months of operating history exists. In either case, the load factor is based on the customer's maximum actual demand (kW) times the total hours divided into the energy (kWh) used.

The customer will be responsible to the Company for any additional cost of installing and removing any equipment required to meter or deliver the requested extra energy.

DEFINITION:

The Supplemental Energy billed under this schedule shall be the product of the current month load factor, the number of hours the customer receives Supplemental Energy, and the additional demand used. The additional demand used during an on-peak period is the difference between the maximum kW measured during the period of supplemental energy sales and the greater of: the maximum kW used on-peak during a curtailment period, or the established billing demand. The additional demand used during an off-peak period is the difference between the maximum kW measured during the period of supplemental energy sales and the greater of: the maximum kW used off-peak during a curtailment period or the off-peak threshold (billing demand divided by the off-peak ratchet).

PROOF OF ABILITY TO REDUCE LOAD:

The customer must demonstrate his ability to curtail his load to the firm tariff level during each year that he is subjected to SE curtailments. Failure to curtail load to the firm tariff level will result in the establishment of a new firm billing demand, subject to the ratchet provisions of the applicable firm tariff.

COGENERATION:

Customers having cogeneration capability shall be required to take service on the Company's Limited Standby Service Rider or the Back-Up Service Rider. Supplemental Energy shall not be available as a replacement for service on the Limited Standby Service Rider or the Back-Up Service Rider.

LIMITATION:

This service will be provided if and when the Company has supplemental energy available. Supplemental energy will not be available at any time the Company's delivered costs exceed the Monthly Energy Rate plus Fuel Cost Recovery. The Company shall have the right to curtail or deny service under this agreement at any time solely at the option of the Company. The minimum notification time for curtailment or denial shall be 30 minutes. Usage metered at the customer's premise during a period of unavailability or curtailment shall be billed on the rate under which the customer's regular service is provided.

UR-10

LIQUIDATED DAMAGES:

The customer's actual demand during each continuous period of supplemental energy purchases is limited to the nameplate capacity of the Company facilities on the customer's premise provided for his regular service. The customer shall pay $30.00 per kW per occurrence as liquidated damages for exceeding this limit. The liquidated damages will be applied to the differences between the peak demands established and the nameplate capacity of the Company facilities on the customer's premise provided for his regular service.

TYPE OF SERVICE:

Three phase, 60 hertz, at the voltage the customer's regular service is provided.

MONTHLY RATE:

Administrative Charge...$155.00
On-Peak Energy Charge...1.97¢ per kWh
Off-Peak Energy Charge...1.27¢ per kWh
Demand Charge (On-Peak, June-September)...$0.80 per kW

FUEL COST RECOVERY:

The amount calculated at the above rate will be increased under the provisions of the Company's effective Fuel Cost Recovery Schedule, including any applicable adjustments.

MINIMUM BILLING DEMAND:

The minimum billing demand on the referenced rider shall be ninety-five percent (95%) of the billing demand at time of contract.

REVENUE ADJUSTMENT:

The bill calculated at the above rate is subject to change in such an amount as may be determined under the provisions of the Company's Revenue Adjustment Rider, Schedule "RA-1", as approved by the Georgia Public Service Commission or as may be later amended.

Service hereunder subject to Rules and Regulations for Electric Service on file with the Georgia Public Service Commission.

RS&H®

Telephone Call Confirmation

Project Number ______

~~(706) 724-5225~~
(706) ~~739~~ 650 - 5225

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 2/12/96

Conversed with Michael Richardson Of Georgia Power

Regarding Ft. Gordon Rates - Applicability of RTP rates

Two types of RTP rates
RTP-DA - day ahead - any size demand
Cannot have IS rate - Get prices
one day ahead - 24 prices
RTP-HA - hour ahead > 10 MW
Must have IS rate also
Get prices 1 hr ahead

Under RTP costs up to Customer Base Load (CBL)
are fixed - credits & debit are added for each hour
CBL based on 2 pts, 360 pts, or 8760 pts

Distribution:

UR-12

RS&H®

Telephone Call Confirmation

Project Number ______________

(706) 481-1484

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 11/29/95

Conversed with Ian Skelton Of Atlanta Gas Light Co

Regarding Ft. Gordon Natural Gas Prices

100% interruptible

Monthly gas supply program

I.S. will send historical and projected rates

Distribution:

UR-13

NOV-29-1995 15:43 FROM GEORGIA NATURAL GAS TO 919042792489 P.01

GEORGIA NATURAL GAS COMPANY P. O. Box 1426, Augusta, Georgia 30913-3699

FAX

Date: 11/29/95

Number of pages including cover sheet: ~~3~~ 4

To: Paul Hutchins

Phone:

Fax phone: 904-279-2489

CC:

From: Ian Skelton

Phone:

Fax phone: 706-481-1495 or 1498

REMARKS: ☐ Urgent ☑ For your review ☐ Reply ASAP ☐ Please comment

Paul,

Enclosed is a 2 year history of city-gate gas prices into Augusta. A 12 month strip on the futures market is going for about 23.8 ¢/therm. 3.2 ¢/therm local transportation needs to be added to get the total burner tip price.

Eg. Burner tip price projection for next 12 months:

23.8 + 3.2 = 27.0 cents/therm

Please call me if I can provide any more info.

Thanks. Ian

UR-14'

Atlanta Gas Light Company
Menu of Services Sales Gas Prices
(Cents per therm city gate cost. including AGLC loss factor)
Connecting Pipeline - Southern Natural Gas Company

Oct-93	24.821
Nov-93	26.619
Dec-93	30.493
Jan-94	29.669
Feb-94	33.440
Mar-94	32.475
Apr-94	26.114
May-94	24.690
Jun-94	23.023
Jul-94	25.262
Aug-94	24.013
Sep-94	20.941
Oct-94	20.925
Nov-94	23.700
Dec-94	23.714
Jan-95	22.860
Feb-95	21.355
Mar-95	21.070
Apr-95	21.040
May-95	21.883
Jun-95	22.040
Jul-95	20.000
Aug-95	18.890
Sep-95	20.784
Oct-95	21.620
Nov-95	23.110

UR-15

C. COMPUTER SIMULATION MODEL

TRACE RESULTS
BASELINE

		Natural Gas		
		Energy	(MBtu)	Cost
(Therms)	Month	Actual	Calc'd	Actual
64,100	Oct	5,588	6,396	$13,858
69,100	Nov	6,947	6,706	$18,270
83,800	Dec	8,378	8,086	$22,379
99,400	Jan	9,810	9,674	$26,487
91,000	Feb	8,653	8,943	$23,364
73,100	Mar	7,679	7,319	$20,733
55,100	Apr	6,599	5,434	$17,818
48,000	May	5,998	4,834	$16,196
40,600	Jun	4,709	4,139	$12,713
44,700	Jul	4,024	4,380	$10,865
42,700	Aug	4,300	4,375	$11,611
46,100	Sep	5,325	4,566	$14,378
183,200	Total	78,011	74,852	$208,671

Difference (%) -4.0%

December is the average of Nov. & Jan.

			Electricity		
	Demand	(kw)	Energy	(kWh)	Cost
Month	Actual	Calc'd	Actual	Calc'd	Actual
Oct	3697	3,168	2,127,600	1,941,447	$90,600
Nov	3730	3,156	1,882,800	1,826,226	$85,300
Dec	3319	3,090	1,674,000	1,818,304	$80,900
Jan	3308	3,063	1,886,400	1,745,179	$85,800
Feb	3312	3,060	1,501,200	1,547,225	$76,800
Mar	3380	3,143	1,980,000	1,900,011	$87,900
Apr	3388	3,233	1,778,400	2,004,009	$83,500
May	3884	3,745	2,091,600	2,180,392	$90,300
Jun	3694	4,027	2,192,400	2,379,426	$95,900
Jul	4021	3,977	2,412,000	2,502,234	$101,200
Aug	4101	4,060	2,509,200	2,477,762	$104,000
Sep	4010	3,909	2,260,800	2,215,920	$98,100
			24,296,400	24,538,135	$1,080,300

Difference (%) 1.0%

RS-1

FINAL

TRACE RESULTS
AFTER RENOVATION PROJECT - NEW BASELINE

		Natural Gas		
		Energy	(MBtu)	Cost
(Therms)	Month	Actual	Calc'd	Actual
64,100	Oct	5,588	5,241	$13,858
69,100	Nov	6,947	5,510	$18,270
83,800	Dec	8,378	6,570	$22,379
99,400	Jan	9,810	7,832	$26,487
91,000	Feb	8,653	7,340	$23,364
73,100	Mar	7,679	6,019	$20,733
55,100	Apr	6,599	4,556	$17,818
48,000	May	5,998	4,119	$16,196
40,600	Jun	4,709	3,575	$12,713
44,700	Jul	4,024	3,788	$10,865
42,700	Aug	4,300	3,785	$11,611
46,100	Sep	5,325	3,911	$14,378
183,200	Total	78,011	62,246	$208,671

Difference (%) -20.2%

			Electricity		
	Demand	(kw)	Energy	(kWh)	Cost
Month	Actual	Calc'd	Actual	Calc'd	Actual
Oct	3697	2,895	2,127,600	1,738,703	$90,600
Nov	3730	2,868	1,882,800	1,628,428	$85,300
Dec	3319	2,755	1,674,000	1,612,416	$80,900
Jan	3308	2,727	1,886,400	1,549,446	$85,800
Feb	3312	2,724	1,501,200	1,375,052	$76,800
Mar	3380	2,818	1,980,000	1,685,463	$87,900
Apr	3388	2,967	1,778,400	1,801,249	$83,500
May	3884	3,391	2,091,600	1,973,666	$90,300
Jun	3694	3,643	2,192,400	2,172,537	$95,900
Jul	4021	3,639	2,412,000	2,287,415	$101,200
Aug	4101	3,688	2,509,200	2,267,537	$104,000
Sep	4010	3,523	2,260,800	2,027,019	$98,100
			24,296,400	22,118,931	$1,080,300

Difference (%) -9.0%

FINAL

TRACE RESULTS - ECO ANALYSIS

FILENAME	ECO ID	ELECTRICITY (kWh)	NAT GAS (therms)	DEMAND (kW)
BASE	(1)	24,538,135	769,130	4,169
RPROJ	(2)	22,118,931	622,460	3,688
DPWIND	BE2	22,118,272	621,844	3,688
DAMPER	HS13	21,521,022	607,408	3,628
SSFSCH	HS24	21,902,632	602,620	3,649
VAV	HS7	21,394,592	603,657	3,633
OSA	HS18	22,078,960	622,137	3,661

Savings with Respect to Renovation Project Model

FILENAME	ECO ID	ELECTRICITY (kWh)	NAT GAS (therms)	DEMAND (kW)
BASE	-	-	-	-
RPROJ	-	-	-	-
DPWIND	BE2	659	616	0
DAMPER	HS13	597,909	15,052	60
SSFSCH	HS24	216,299	19,840	39
VAV	HS7	724,339	18,803	55
OSA	HS18	39,971	323	27

Savings with Respect to Renovation Project Model

FILENAME	ECO ID	ELECTRICITY (MBtu)	NAT GAS (MBtu)	DEMAND (kW)
BASE	-	-	-	-
RPROJ	-	-	-	-
DPWIND	BE2	2	62	0
DAMPER	HS13	2,041	1,505	6
SSFSCH	HS24	738	1,984	4
VAV	HS7	2,472	1,880	6
OSA	HS18	136	32	3

Savings with Respect to Renovation Project Model

FILENAME	ECO ID	ELECTRICITY	NAT GAS	TOTALS
BASE	-	-	-	-
RPROJ	-	-	-	-
DPWIND	BE2	$17	$166	$183
DAMPER	HS13	$15,546	$4,064	$19,610
SSFSCH	HS24	$5,624	$5,357	$10,981
VAV	HS7	$18,833	$5,077	$23,910
OSA	HS18	$1,039	$87	$1,126

(1) Baseline (Existing Conditions)
(2) After implementation of FY96 Renovation Project

BASELINE ENERGY USE BY SYSTEM

	ELEC (kWh/yr)	ELEC (MBtu/yr)	GAS (kBtu/yr)	GAS (MBtu/yr)
DHW	0	0.0	33,155,482	33155.48
Heating	141,956	484.5	41,283,280	41283.28
Cooling	4,628,607	15,797.4	0	0
Auxiliary	6,958,337	23,748.8	0	0
Lighting	7,125,803	24,320.4	0	0
Misc.	5,577,569	19,036.2	0	0
Totals	24,432,271	83,387	74,438,762	74,439

TOTALS (MBtu/yr)	%	COSTS ($)	EL ($)	NG ($)
33,155.5	6.9%	$89,520	$0	$89,520
41,767.8	9.1%	$117,853	$6,388	$111,465
15,797.4	16.0%	$208,287	$208,287	$0
23,748.8	24.1%	$313,125	$313,125	$0
24,320.4	24.7%	$320,661	$320,661	$0
19,036.2	19.3%	$250,991	$250,991	$0
157,826	100.0%	$1,300,437	$1,099,452	$200,985

EISENHOWER ARMY MEDICAL CENTER
TOTAL SAVINGS SUMMARY

	Natural Gas				Electricity				Total Energy			
	Energy (MBtu)	%	Cost	%	Energy (MBtu)	%	Cost	%	Energy (MBtu)	%	Cost	%
Baseline	78,000	-	$ 209,000	-	82,900	-	$ 1,080,000	-	160,900	-	$ 1,289,000	-
Major Renovation	(8,000)		$ (21,000)		(8,200)		$ (108,000)		(16,200)		$ (129,000)	
Savings	70,000	10.3%	$ 188,000	10.0%	74,700	9.9%	$ 972,000	10.0%	144,700	10.1%	$ 1,160,000	10.0%
RSH Study	(3,100)	4.4%	$ (8,300)	4.4%	(5,500)	7.4%	$ (120,800)	12.4%	(8,600)	5.9%	$ (129,100)	11.1%
Savings	66,900	14.2%	$ 179,700	14.0%	69,200	16.5%	$ 851,200	21.2%	136,100	15.4%	$ 1,030,900	20.0%

RS-5

FINAL

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**                                                                         **
**              T R A C E   6 0 0   A N A L Y S I S                        **
**                                                                         **
**              by  C.D.S. MARKETING                                       **
**                                                                         **
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EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
BASELINE ~~W REDUCE CHILLER KW~~

Weather File Code:	AUGUSTA	
Location:		
Latitude:	33.0	(deg)
Longitude:	82.0	(deg)
Time Zone:	5	
Elevation:	143	(ft)
Barometric Pressure:	29.8	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	95	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	23	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

Design Simulation Period: July To July
System Simulation Period: January To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 10:40:13 6/26/96
Dataset Name: BASE2 .TM

BL-1

Trane Air Conditioning Economics
By: C.D.S. MARKETING

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,745,179	3,063	96,740	2,211	219
Feb	1,547,225	3,060	89,433	1,947	219
March	1,900,011	3,143	73,186	2,327	214
April	2,004,009	3,233	54,340	2,584	190
May	2,180,392	3,745	48,344	3,031	183
June	2,379,426	4,027	41,394	3,748	177
July	2,502,234	3,977	43,799	3,996	179
Aug	2,477,762	4,060	43,752	3,981	180
Sept	2,215,920	3,909	45,664	3,254	182
Oct	1,941,447	3,168	63,959	2,330	196
Nov	1,826,226	3,156	67,055	2,164	208
Dec	1,818,304	3,090	80,856	2,167	216
Total	24,538,136	4,060	748,522	33,739	219

Building Energy Consumption = 216,508 (Btu/Sq Ft/Year)   Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 450,573 (Btu/Sq Ft/Year)

BL-2

Trane Air Conditioning Economics
By: C.D.S. MARKETING

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

-------------------------------------- U T I L I T Y   P E A K   C H E C K S U M S --------------------------------------

Utility   ELECTRIC DEMAND

Peak Value   4,060.1   (kW)
Yearly Time of Peak   21 (hr)   8 (mo)

Hour 21   Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	752.2	18.53
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	752.2	18.53
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.0	0.64
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	64.8	1.60
Sub Total			1,595.3	39.29
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.38
Sub Total			56.0	1.38
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.52
2		SUMMATION OF FAN ELECTRICAL DEMAND	101.0	2.49
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.04
4		SUMMATION OF FAN ELECTRICAL DEMAND	115.7	[illegible]
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.[illegible]
6		SUMMATION OF FAN ELECTRICAL DEMAND	34.7	0.86
7		SUMMATION OF FAN ELECTRICAL DEMAND	117.2	2.89
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.7	0.21
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	1.87
Sub Total			661.5	16.29
Sub Total			0.0	0.00
Miscellaneous				
Lights			976.8	24.06
Base Utilities			0.0	0.00
Misc Equipment			770.6	18.98
Sub Total			1,747.3	43.04
Grand Total			4,060.1	100.00

BL-3

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

-- CALIFORNIA TITLE 24 COMPLIANCE REPORT --

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

-------------------------------------- E N E R G Y U S E S U M M A R Y --------------------------------------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	43,390,748.0	394.6	27.7	47,128,104.0	65.9
Primary Cooling						
Compressor	3,173,624.0	0.0	0.0	6.8	32,497,984.0	45.5
Tower/Cond Fans	420,407.3	0.0	33,058.3	0.9	4,304,981.0	6.0
Condenser Pump	1,043,609.4	0.0	0.0	2.2	10,686,585.0	15.0
Other Accessories	11,808.3	0.0	0.0	0.0	120,917.3	0.2
Auxiliary						
Supply Fans	5,802,712.0	0.0	0.0	12.5	59,419,908.0	83.1
Circulation Pumps	1,519,039.7	0.0	0.0	3.3	15,555,003.0	21.8
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	7,321,752.0	0.0	0.0	15.8	74,974,912.0	104.9
Lighting	7,125,802.5	0.0	0.0	15.3	72,968,384.0	99.6
Receptacle	5,299,176.5	0.0	0.0	11.4	54,263,692.0	74.1
Domestic Hot Water	0.0	31,461,406.0	286.1	19.8	33,117,270.0	45.2
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	24,538,136.0	74,852,152.0	33,738.9	100.0	330062816.0	456.4

INPUT ECHO - BASELINE

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: BASELINE ~~W REDUCE CHILLER KW~~

Card 08 - Climatic Information

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09 - Load Simulation Periods

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10 - Load Simulation Parameters

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11 - Energy Simulation Parameters

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

Load Section Alternative #1

Card 19- Load Alternative -

Number	Description
1	BASELINE

Card 20-- General Room Parameters --

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
M100	100	FLR1 NP ADMIN	7400	1	7	6.5		16.5			20
110	110	FLR1 EP ADMIN	1800								
120	120	FLR1 SP ADMIN	4200								
130	130	FLR1 WP ADMIN	2200								
140	140	FLR1 INT ADMIN	47200								
160	160	FLR1 EP LABS	2200								
170	170	FLR1 SP LABS	3400								
180	180	FLR1 INT LABS	16000								
190	190	FLR1 MECH RM	4000								
210	210	FLR2 NP LOBBY	1600								
215	215	FLR2 INT LOBBY	5600								
220	220	FLR2 NP EMERG'CY	3000								
222	222	FLR2 EP EMERG'CY	1000								
224	224	FLR2 INT EMERG'Y	10400								
230	230	FLR2 EP ADMIN	1400								
232	232	FLR2 SP ADMIN	7800								
234	234	FLR2 WP ADMIN	4000								
236	236	FLR2 NP ADMIN	1700								
238	238	FLR2 IN ADMIN	76750								
240	240	FLR2 MECH RM	6750								
250	250	FLR2 MRI	2940								
260	260	FLR1 NP FAM PRAC	3620								
262	262	FLR2 EP FAM PRAC	2320								
264	264	FLR2 SP FAM PRAC	3620								
268	268	FLR2 INT FAM PRA	16416								
300	300	FLR3 KITCHEN CLD	4550								
302	302	FLR3 KITCHEN VND	3000								
310	310	FLR3 NP DINING	3000								
315	315	FLR3 IN DINING	15000								
320	320	FLR3 NP ADMIN	3000								
322	322	FLR3 EP ADMIN	1800								
324	324	FLR3 WP ADMIN	2000								
326	326	FLR3 IN ADMIN	40400								
330	330	FLR3 EP SURGICAL	3800								
332	332	FLR3 SP SURGICAL	1800								
334	334	FLR3 IN SURGICAL	14400								
340	340	FLR3 SP SUPPLY	5800								
342	342	FLR3 WP SUPPLY	1400								
346	346	FLR3 IN SUPPLY	16800								
350	350	FLR3 MECH ROOM	3250								
M400	400	FLR4 NP ADMIN	5600	1	7	6		15			20
410	410	FLR4 EP ADMIN	1200								
420	420	FLR4 SP ADMIN	5600								
430	430	FLR4 WP ADMIN	1200								
440	440	FLR4 IN ADMIN	8600								
510	510	FLR5 NP ICU	1600								
512	512	FLR5 SP ICU	1600								

Card 20--- General Room Parameters ---

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
514	514	FLR5 WP ICU	1340								
516	516	FLR5 IN ICU	2390								
520	520	FLR5 NP ADMIN	1400								
522	522	FLR5 SP ADMIN	1400								
524	524	FLR5 IN PATIENTS	2590								
530	530	FLR5 NP PATIENTS	2600								
532	532	FLR5 EP PATIENTS	1340								
534	534	FLR5 SP PATIENTS	2600								
536	536	FLR5 IN PATIENTS	4240								
M610	610	FLR6 NWP PATIENT	1800	1	7	2.5		11.5			20
612	612	FLR6 SWP PATIENT	1800								
614	614	FLR6 WP PATIENT	1400								
616	616	FLR6 IN PATIENT	4000								
620	620	FLR6 NP ADMIN	2000								
622	622	FLR6 SP ADMIN	2000								
624	624	FLR6 IN ADMIN	5000								
630	630	FLR6 NEP PATIENT	1800								
632	632	FLR6 EP PATIENT	1400								
634	634	FLR6 SP PATIENT	1800								
636	636	FLR6 IN PATIENT	4000								
710	710	FLR7 NP PATIENT	2400						7		
712	712	FLR7 SP PATIENT	2400						7		
714	714	FLR7 WP PATIENT	1400						7		
716	716	FLR7 WP PATIENT	5500						7		
720	720	FLR7 NP ADMIN	3200						7		
722	722	FLR7 EP ADMIN	1400						7		
724	724	FLR7 SP ADMIN	3200						7		
726	726	FLR7 IN ADMIN	7500						7		
800	800	FLR14 W MECH	5625								
810	810	FLR14 E MECH	5625								
M900	900	MED BARRKS NP	3300	1	3	4		22.6	3		
902	902	MED BARRKS EP									
904	904	MED BARRKS SP									
906	906	MED BARRKS WP									
908	908	MED BARRKS WP	21025								

Card 21--------------------------------- Thermostat Parameters --

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
M100	75	50	76	CL_76	73	75	HT_75	ZONE	MED70	NO

Card 22------------------------- Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
250	1	YES			0.04	162			
M260	1	YES			0.06	160			
262	1								
264	1								
268	1								
300	1								
310	1								
315	1								
320	1								
322	1								
326	1		12400	1					
710	1								
712	1								
714	1								
716	1		700	1					
720	1								
722	1								
724	1								
726	1		1050	1					
900	1								
902	1								
904	1								
906	1								
908	1		233	100					

Card 24--------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
210	1	80	16.5	0.068	161	0			
220	1	160				0			
222	1	50				90			
230	1	70				90			
250	1	70	12	0.056	163	0			
250	2	40	12	0.056	163	90			
250	3	70	12	0.056	163	180			
260	1	191	12			0			
262	1	136	12			90			
264	1	191	12			180			
300	1	40				0			
310	1	150				0			
320	1	160				0			
322	1	160				90			
324	1	100				270			
330	1	100				90			
M400	1	300	15	0.068	161	0			
410	1	74				90			
420	1	300				180			
430	1	74				270			

Card 24--------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
510	1	90				0			
512	1	90				180			
514	1	77				270			
520	1	70				0			
522	1	70				180			
530	1	140				0			
532	1	77				90			
534	1	140				180			
M610	1	100	11.5	0.068	161	0			
612	1	100				180			
614	1	90				270			
620	1	100				0			
622	1	100				180			
630	1	100				0			
632	1	90				90			
634	1	100				180			
710	1	130				0			
712	1	130				180			
714	1	90				270			
720	1	170				0			
722	1	90				90			
724	1	170				180			
900	1	185	22.6			0			
902	1	185	22.6			90			
904	1	185	22.6			180			
906	1	185	22.6			270			

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
M300	1			10	1.04	0.9					
310	1			75		0.8					
320	1			5							
M400	1			50	1.04	0.9		3			
410	1										
420	1										
430	1										
M510	1			20	1.04	0.9	3	3			
512	1										
514	1										
520	1										
522	1										
530	1										
532	1										

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
534	1										
M610	1			10	1.04	0.9	3	3			
612	1										
614	1										
620	1										
622	1										
630	1										
632	1										
634	1										
710	1										
712	1										
714	1										
720	1										
722	1										
724	1										
M900	1			20	1.04	1.		3			
902	1										
904	1										
906	1										

Card 26-- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
M100	A-P8HPD	A-L8HPD	AVAIL	OFF		AVAIL	AVAIL	AVAIL	AVAIL	
160	AVAIL	AVAIL								
170	AVAIL	AVAIL								
180	AVAIL	AVAIL								
190	NONE	NONE	NONE	NONE		NONE	NONE			
M210	AVAIL	AVAIL	AVAIL	AVAIL		AVAIL	AVAIL	AVAIL	AVAIL	
240	NONE	NONE	NONE	NONE		NONE	NONE			
M300	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
330	A-P8HPD	A-L8HPD								
332	A-P8HPD	A-L8HPD								
334	A-P8HPD	A-L8HPD								
350	NONE	NONE	NONE	NONE		NONE	NONE			
M510	AVAIL	AVAIL	AVAIL	OFF		AVAIL	AVAIL		AVAIL	
M610	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
800	NONE	NONE	NONE	NONE		NONE	NONE			
810	NONE	NONE	NONE	NONE		NONE	NONE			

Card 27------------------------------------- People and Lights --

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
M	309	SF-PERS	250	200	1.5	WATT-SF	RECFL-RS		75		

Card 27------------------------------------ People and Lights --

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
160					3.5						
170					3.5						
180					3.5						
190	0	SF-PERS									
240	0	SF-PERS									
350	0	SF-PERS									
400	200	SF-PERS			2.7	WATT-SF					
410	200	SF-PERS			2.7	WATT-SF					
420	200	SF-PERS			2.7	WATT-SF					
430	200	SF-PERS			2.7	WATT-SF					
440	200	SF-PERS			2.7	WATT-SF					
800	0	SF-PERS									
810	0	SF-PERS									
M900	150	SF-PERS			0	WATT-SF					

Card 28-- Miscellaneous Equipment ---

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
M	1	MISC EQUIP	1.08	WATT-SF	A-L8HPD	ELEC					
160	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
170	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
180	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
250	1	MISC EQUIP	3.00	WATT-SF	A-L8HPD	ELEC					
M900	1	MISC ELEC	1.	WATT-SF	HOTRLGT	NONE					

Card 29--- Room Airflows --

Room	-------------Ventilation-------------				-------------Infiltration------------					
	-----Cooling-----		-----Heating-----		-----Cooling-----		-----Heating-----		--Reheat Minimum--	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
M100	19	PCT-MCLG	19	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
M210	19	PCT-MCLG	19	PCT-MCLG	0.75	ACH-HR	0.75	ACH-HR	100	PCT-MCLG
302	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
330	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
332	100	PCT-MCLG	100	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
334	100	PCT-MCLG	100	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
M400	32	PCT-MCLG	32	PCT-MCLG	0.25	ACH-HR	0.25	ACH-HR	100	PCT-MCLG
M510	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
M620	32	PCT-MCLG	32	PCT-MCLG	0.25	ACH-HR	0.25	ACH-HR	100	PCT-MCLG
800	0	CFM	0	CFM	0	CFM	0	CFM		
810	0	CFM	0	CFM	0	CFM	0	CFM		

Card 29-- Room Airflows --

	Ventilation				Infiltration					
Room	Cooling		Heating		Cooling		Heating		Reheat Minimum	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
M900	15	PCT-MCLG	15	PCT-MCLG	0.50	ACH-HR	0.50	ACH-HR	100	PCT-MCLG

Card 30---------------------------------- Fan Airflows --

	Main				Auxiliary					
Room	Cooling		Heating		Cooling		Heating		Room Exhaust	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
M100									19	PCT-MCLG
190	0	CFM	0	CFM						
240	0	CFM	0	CFM						
302	39400	CFM							39400	CFM
350	0	CFM	0	CFM						
M400									32	PCT-MCLG
M510									100	PCT-MCLG
M620									32	PCT-MCLG
800	0	CFM	0	CFM						
810	0	CFM	0	CFM						
M900									15	PCT-MCLG

Card 33-------------------------------- External Shading --------------------------------------

	OVERHANG			VERTICAL FINS					
Shading Type	Glass Height	Height Above Glass	Projection Out	Glass Width	Projection Left	Left Projection Out	Projection Right	Right Projection Out	Adjacent Building Flag
3	4	1	2.5	6	1	2.5	3	2.5	

Card 34------------------------------------ Internal Shading ---

						Lockouts				
Shading Type	Overall U-Value	Overall Shading Coefficent	Schedule Code	Shade Location	Visible Transmittance	Min OADB	Max Solar	Solar Ctrl Prob	Max Glare	Glare Ctrl Prob
3	0.81	0.2	AVAIL	INSIDE	0.2		35	95		

-------------------- System Section Alternative #1 --------------------

Card 39- System Alternative

Number	Description
1	BASELINE

Card 40---------------------- System Type ------------------------------

System Set Number	System Type	OPTIONAL VENTILATION SYSTEM: Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
1	VRH						
2	VRH						
3	VRH						
4	VRH						
5	VRH						
6	VRH						
7	VRH						
8	PTAC						
9	FPVAV						
10	UV						
11	FC						

Card 41-- Zone Assignment ---

System Set Number	Ref #1 Begin	Ref #1 End	Ref #2 Begin	Ref #2 End	Ref #3 Begin	Ref #3 End	Ref #4 Begin	Ref #4 End	Ref #5 Begin	Ref #5 End	Ref #6 Begin	Ref #6 End
1	100	190										
2	210	240										
3	300	300	310	326	340	350						
4	400	410	630	636	720	726	810	810				
5	510	516	612	612	616	616	622	622				
6	330	334										
7	420	440	520	536	610	610	614	614	620	620	624	624
8	250	250										
9	260	268										
10	302	302										
11	900	908										

-- Zone Assignment ---

Ref #7 Begin	Ref #7 End	Ref #8 Begin	Ref #8 End	Ref #9 Begin	Ref #9 End	Ref #10 Begin	Ref #10 End	Ref #11 Begin	Ref #11 End
710	716	800	800						

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	6.4		0.6			0.75	SUPPLY	OMIT			
2	5.7		1			0.75	SUPPLY	OMIT			
3	6.6					0.75	SUPPLY				
4	5.5		0.8			0.75	SUPPLY	OMIT			
5	5.6					0.75	SUPPLY				
6	5.5					0.75	SUPPLY				
7	5.75		1			0.75	SUPPLY	OMIT			
8	2.5					0.75	SUPPLY				
9	2.5					0.75	SUPPLY				
10	2.8					0.75	OMIT				
11	2.0					0.75	SUPPLY				

Card 43------------------------ Airflow Design Temperatures ------------------------------

System Set Number	Minimum Cooling SADB	Maximum Cooling SADB	Minimum Heating SADB	Maximum Heating SADB	Minimum Cooling Lv DB	Maximum Cooling Lv DB	Minimum Preheat Lv DB	Maximum Preheat Lv DB	Minimum Room RH	Design Ht Rec Diff
2										
3										
4										
5									40	
6									40	

Card 44--- System Options --

System Set Number	Econ Type Flag	Econ On Point	Max Pct Outside Air	Direct Evap Cooling	Indirect Evap Cooling	1st Stage Evap Cooling	Fan Cycling	Exhaust Air Heat Recovery: Effectiveness Stage 1	Effectiveness Stage 2	Control Type Stage 1	Control Type Stage 2	Exh-Side Deck Stage 1	Exh-Side Deck Stage 2
1	DRY-BULB	50	75										
2	DRY-BULB	50	75										
3	DRY-BULB	50	75										
4	DRY-BULB	50	75										
5													
6													
7	DRY-BULB	50	75										
8													
9													

Card 45-------------------------------------- Equipment Schedules ---

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
2	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
3	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE

Card 45------------------------------------- Equipment Schedules --

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
4	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
5	AVAIL	NONE	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
6	AVAIL	NONE	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	AVAIL	NONE
7	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
8	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
9	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE
10	NONE	NONE	NONE	NONE	NONE	AVAIL	NONE	NONE	NONE	NONE
11	AVAIL	NONE	NONE	NONE	NONE	AVAIL	AVAIL	NONE	NONE	NONE

Card 47------------------------------- Fan Overrides -------------------------------------

Sys Set Num	Clg Fan Eff	Htg Fan Eff	Ret Fan Eff	Mn Exh Fan Eff	Aux Fan Eff	Rm Exh Fan Eff	Opt Vnt Sys Fan Eff	Mech Eff	----------MAIN COOLING FAN--------- Air Value	Air Units	Size Meth	Confg
1				90		90		75	79000	CFM	BLOCK	DRAW
2				90		90		75	91000	CFM	BLOCK	DRAW
3				90		90		75	79000	CFM	BLOCK	DRAW
4				90		90		75	107000	CFM	BLOCK	DRAW
5				90		90		75	17000	CFM	BLOCK	DRAW
6				90		90		75	32000	CFM	BLOCK	DRAW
7				90		90		75	102000	CFM	BLOCK	DRAW
8	85	85										
9	88	88		88								
10	90			90								

Card 48------------------------- Cooling Capacity Overrides --------------------------------

System Set Number	People Variance	Lights Variance	Misc Loads Variance	------------MAIN Capacity Value	Capacity Units	COOLING----------- Capacity Sizing	Capacity Location	---AUX COOLING---- Capacity Value	Capacity Units
1						BLOCK			
2						BLOCK			
3						BLOCK			
4						BLOCK			
5						BLOCK			
6						BLOCK			
7						BLOCK			
8						BLOCK			
9						BLOCK			
10						BLOCK			
11						BLOCK			

-------------------- Equipment Section Alternative #1 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ---------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1			5000		AVAIL	

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	PKPLANT	1	7	11	11														
2	4	PKPLANT	8	8																
3	5	PKPLANT	9	9																

Card 62----------------------------------- Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	COOLING Capacity Value	Capacity Units	COOLING Energy Value	Energy Units	HEAT RECOVERY Capacity Value	Capacity Units	HEAT RECOVERY Energy Value	Energy Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001L	1	1000	TONS	0.65	KW-TON					1	PAR	
2	EQ1001L	1	1000	TONS	0.65	KW-TON					2	PAR	
3	THRMCHHE	1	000	TONS	1.07	COP					3	PAR	
4	EQ1307	1	20	TONS	1.38	KW-TON							
5	EQ1120L	1	90	TONS	1.3	KW-TON							

Card 63---------------------------- Cooling Pumps and References -----------------------------------

Cool Ref Num	CHILLED WATER Full Load Value	CHILLED WATER Full Load Units	CONDENSER Full Load Value	CONDENSER Full Load Units	HT REC or AUX Full Load Value	HT REC or AUX Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	135	HP	125	HP					1	
2	135	HP	125	HP					2	
3	0	HP	0	HP					3	
5	5	HP								

Card 64--------------------------- Cooling Equipment Options -----------------------------------

Cool Ref Num	Max CW Reset	Load Shed Economizer	Evap Precool	Free Cooling Type	Heat Source	Cond Entering Temp	Cond Min Oper Temp	Cond Rej To Ref Type	Cond Rej To Ref Number	Cond Rej @ HW Temp
1						95	80			
2						95	80			
3						95	80			

Card 65-- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	11																

Card 67-------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	EQ2002	1	40	HP	15000	MBH	68.5	PCTEFF						
2	EQ2002	1	40	HP	15000	MBH	68.5	PCTEFF						
3	EQ2002	1	40	HP	15000	MBH	68.5	PCTEFF						

Card 69--------------------- Fan Equipment Parameters --------------------------

System Set Number	Cooling Fan	Heating Fan	Return Fan	Exhaust Fan	Auxiliary Supply	Room Exhaust	Optional Ventilation
1	EQ4001		EQ4004			SAMPLE-F	
2	EQ4001		EQ4004			SAMPLE-F	
3	EQ4001					SAMPLE-F	
4	EQ4001		EQ4004			SAMPLE-F	
5	EQ4001					SAMPLE-F	
6	EQ4001					SAMPLE-F	
7	EQ4001		EQ4004			SAMPLE-F	
8	EQ4001					SAMPLE-F	
9	EQ4001					SAMPLE-F	
10	EQ4001					SAMPLE-F	
11	EQ4000					EQ4000	

Card 70------------------- Fan Equipment KW Overrides ----------------------

	-----MAIN SYSTEM-----				--OTHER SYSTEM--			----DEMAND LIMIT PRIORITY---				
System Set Number	Cool Fan KW	Heat Fan KW	Ret Fan KW	Exh Fan KW	Aux Sup KW	Room Exh KW	Opt Vent KW	Cool Fan	Heat Fan	Aux Fan	Room Exh Fan	Opt Vent Fan
1	80		25									
2	80		25									
3	80											
4	100		13									
5	17											
6	33											
7	100		13									
8												
9												
10	16					60						
11												

Card 71---------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	DOM HOT WATER	11600	MBH	BLGBASE2	HOT-LD	1		60	140

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			0.07	KW-TON	T-WATER	CTOWER	2			
2	EQ5100			0.07	KW-TON	T-WATER	CTOWER	2			
3	EQ5100			0.00	KW	T-WATER	CTOWER	1			

Utility Description Reference Table

Schedules:
A-L8HPD LIGHTS 8HR/DA
A-P8HPD PEOPLE 8HR/DA
AVAIL AVAILABLE (100%)
BLGBASE2 HOSPITAL BLG TEMPLATE HOT WATER SCHEDULE
CL_76 COOLING TSTAT - CONST 76F
HOTRLGT HOTEL ROOMS LIGHTS
HT_75 HEATING TSTAT - CONST 75F
NONE ANY PROJECT
OFF ALWAYS OFF
System:
FC FAN COIL
FPVAV FAN POWERED VAV
PTAC PACKAGED TERMINAL AIR COND.
UV UNIT VENTILATOR
VRH VARIABLE VOLUME REHEAT
Equipment:
Cooling:
EQ1001L 2-STG CENTRIFUGAL CHILLER >550 TONS
EQ1120L AIR-CLD RECIPROCATING > 22 TONS
EQ1307 PACKAGED TERMINAL AIR CONDITIONER
THRMCHHE TRANE DIRECT FIRED ABSORBER, 1.07 COP
Heating:
EQ2002 GAS FIRED STEAM BOILER
Fan:
EQ4000 PREVENTS CONSUMPTION OF FAN ENERGY
EQ4001 AIR FOIL CENTRIFUGAL - CONSTANT VOLUME
EQ4004 AXIAL FLOW - CONSTANT VOLUME (MODEL Q)
SAMPLE-F SAMPLE GENERIC FAN
Tower:
EQ5100 COOLING TOWER FANS

Schedule Name: A-L8HPD
Project: LIGHTS 8HR
Location: EISENHOWER AMC
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: HTG
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	40
7	100
21	40
24	

Schedule Name: A-P8HPD
Project: PEOPLE 8HR
Location: EISENHOWER AMC
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: HTG
Starting Day Type: DSGN Ending Day Type: WKDY

Hour	Util Percent
0	20
7	100
17	20
24	

Starting Month: JAN Ending Month: HTG
Starting Day Type: SAT Ending Day Type: SUN

Hour	Util Percent
0	20
7	40
16	20
24	

Schedule Name: AVAIL
Project: AVAILABLE (100)
Location:
Client: VERSION 3.0
Program User: C.D.S. MARKETING
Comments: BUILDING TEMPLATE SERIES

Starting Month: JAN Ending Month: HTG
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	100
24	

Schedule Name: BLGBASE2
Project: HOSPITAL BLG TEMPLATE HOT WATER
Location:
Client:
Program User: CDS MARKETING
Comments:

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	7
7	30
12	100
14	15
19	7
24	

Schedule Name: CL_76
Project: COOLING TSTAT - CONST 76F
Location:
Client:
Program User: RS&H, INC.
Comments:

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Temperature
0	76
24	

Schedule Name: HOTRLGT
Project: HOTEL ROOMS LIGHTS
Location:
Client: VERSION 3.0
Program User: C.D.S. MARKETING
Comments: BULDING TEMPLATE SERIES SCHEDU

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	5
6	100
9	50
11	0
17	100
21	5
24	

Schedule Name: HT_75
Project: HEATING TSTAT - CONST 75F
Location:
Client:
Program User: RS&H, INC.
Comments:

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Temperature
0	75
24	

Schedule Name: NONE
Project: ANY PROJECT
Location: ANYWHERE
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: HTG
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	0
24	

Schedule Name: OFF
Project: ALWAYS OFF
Location:
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: HTG
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	0
24	

```
******************************************************************************
******************************************************************************
**                                                                          **
**              T R A C E   6 0 0   A N A L Y S I S                         **
**                                                                          **
**              by  C.D.S. MARKETING                                        **
**                                                                          **
******************************************************************************
******************************************************************************
```

EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
FY96 RENOVATION PROJECT

Weather File Code:	AUGUSTA	
Location:		
Latitude:	33.0	(deg)
Longitude:	82.0	(deg)
Time Zone:	5	
Elevation:	143	(ft)
Barometric Pressure:	29.8	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	95	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	23	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

Design Simulation Period: July To July
System Simulation Period: January To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 15:53: 4 6/26/96
Dataset Name: RPROJ .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

------------------------------------ M O N T H L Y E N E R G Y C O N S U M P T I O N ------------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,549,446	2,727	78,318	2,062	188
Feb	1,375,052	2,724	73,404	1,844	188
March	1,685,463	2,818	60,186	2,167	184
April	1,801,249	2,967	45,559	2,402	164
May	1,973,666	3,391	41,193	2,848	158
June	2,172,537	3,643	35,747	3,574	152
July	2,287,415	3,639	37,878	3,817	154
Aug	2,267,537	3,688	37,848	3,803	155
Sept	2,027,019	3,523	39,112	3,073	157
Oct	1,738,703	2,895	52,412	2,154	169
Nov	1,628,428	2,868	55,099	2,015	180
Dec	1,612,416	2,755	65,704	2,013	187
Total	22,118,930	3,688	622,460	31,773	188

Building Energy Consumption = 188,028 (Btu/Sq Ft/Year) Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 398,640 (Btu/Sq Ft/Year)

RP-2

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

-------------------- U T I L I T Y   P E A K   C H E C K S U M S --------------------

Utility ELECTRIC DEMAND

Peak Value 3,688.2 (kW)
Yearly Time of Peak 18 (hr) 8 (mo)

Hour 18 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	766.6	20.79
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	609.6	16.53
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.8	0.73
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	63.5	1.72
Sub Total			1,466.5	39.76
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.52
Sub Total			56.0	1.52
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.77
2		SUMMATION OF FAN ELECTRICAL DEMAND	102.1	2.77
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.25
4		SUMMATION OF FAN ELECTRICAL DEMAND	115.9	3.14
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.58
6		SUMMATION OF FAN ELECTRICAL DEMAND	34.7	0.94
7		SUMMATION OF FAN ELECTRICAL DEMAND	117.4	3.18
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.4	0.23
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	2.06
Sub Total			662.6	17.96
Sub Total			0.0	0.00
Miscellaneous				
Lights			732.6	19.86
Base Utilities			0.0	0.00
Misc Equipment			770.6	20.89
Sub Total			1,503.1	40.76
Grand Total			3,688.2	100.00

RP-3

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

-- CALIFORNIA TITLE 24 COMPLIANCE REPORT --

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

------------------------------------ E N E R G Y U S E S U M M A R Y ------------------------------------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	35,307,220.0	386.1	26.0	38,619,124.0	54.0
Primary Cooling						
Compressor	2,715,972.0	0.0	0.0	6.7	27,811,618.0	38.9
Tower/Cond Fans	543,983.4	0.0	31,092.2	1.3	5,570,402.5	7.8
Condenser Pump	1,026,209.7	0.0	0.0	2.5	10,508,412.0	14.7
Other Accessories	818,280.7	0.0	0.0	2.0	8,379,213.5	11.7
Auxiliary						
Supply Fans	5,549,719.5	0.0	0.0	13.8	56,829,260.0	79.5
Circulation Pumps	679,279.6	0.0	0.0	1.7	6,955,839.5	9.7
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	6,228,999.0	0.0	0.0	15.4	63,785,096.0	89.3
Lighting	5,344,352.5	0.0	0.0	13.2	54,726,296.0	74.7
Receptacle	5,299,176.5	0.0	0.0	13.1	54,263,692.0	74.1
Domestic Hot Water	0.0	26,938,824.0	294.6	19.6	28,356,658.0	38.7
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	22,118,930.0	62,246,044.0	31,772.8	100.0	292020512.0	403.9

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: FY96 RENOVATION PROJECT

Card 08 ---------- Climatic Information ----------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09 ---------- Load Simulation Periods ----------

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10 ---------- Load Simulation Parameters ----------

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11 ---------- Energy Simulation Parameters ----------

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

---------- Load Section Alternative #1 ----------

Card 19- Load Alternative -

Number	Description
1	BASELINE

Card 25--- Wall/Glass Parameters ---

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
534	1										
M610	1			10	1.04	0.9	3	3			
612	1										
614	1										
620	1										
622	1										
630	1										
632	1										
634	1										
710	1										
712	1										
714	1										
720	1										
722	1										
724	1										
M900	1			20	1.04	1.		3			
902	1										
904	1										
906	1										

Card 26--- Schedules ---

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
M100	A-P8HPD	A-L8HPD	AVAIL	OFF		AVAIL	AVAIL	AVAIL	AVAIL	
160	AVAIL	AVAIL								
170	AVAIL	AVAIL								
180	AVAIL	AVAIL								
190	NONE	NONE	NONE	NONE		NONE	NONE			
M210	AVAIL	AVAIL	AVAIL	AVAIL		AVAIL	AVAIL	AVAIL	AVAIL	
240	NONE	NONE	NONE	NONE		NONE	NONE			
M300	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
302						A-MODSKF			A-MODSKF	
330	A-P8HPD	A-L8HPD								
332	A-P8HPD	A-L8HPD								
334	A-P8HPD	A-L8HPD								
350	NONE	NONE	NONE	NONE		NONE	NONE			
M510	AVAIL	AVAIL	AVAIL	OFF		AVAIL	AVAIL		AVAIL	
M610	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
800	NONE	NONE	NONE	NONE		NONE	NONE			
810	NONE	NONE	NONE	NONE		NONE	NONE			

KITCHEN EXHAUST FAN SCHEDULED OFF AT NIGHT

Card 27------------------------------------ People and Lights --

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
M	309	SF-PERS	250	200	1.125	WATT-SF	RECFL-RS		75		
160					2.625						
170					2.625						
180					2.625						
190	0	SF-PERS									
240	0	SF-PERS									
350	0	SF-PERS									
400	200	SF-PERS			2.025	WATT-SF					
410	200	SF-PERS			2.025	WATT-SF					
420	200	SF-PERS			2.025	WATT-SF					
430	200	SF-PERS			2.025	WATT-SF					
440	200	SF-PERS			2.025	WATT-SF					
800	0	SF-PERS									
810	0	SF-PERS									
M900	150	SF-PERS			0	WATT-SF					

Lighting w/sf reduced by 25%

Card 28--- Miscellaneous Equipment ---
-

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
M	1	MISC EQUIP	1.08	WATT-SF	A-L8HPD	ELEC					
160	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
170	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
180	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
250	1	MISC EQUIP	3.00	WATT-SF	A-L8HPD	ELEC					
M900	1	MISC ELEC	1.	WATT-SF	HOTRLGT	NONE					

Card 29-- Room Airflows --

Room	-------------Ventilation-------------				-------------Infiltration------------				--Reheat Minimum--	
	-----Cooling-----		-----Heating-----		-----Cooling-----		-----Heating-----			
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
M100	19	PCT-MCLG	19	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
M210	19	PCT-MCLG	19	PCT-MCLG	0.75	ACH-HR	0.75	ACH-HR	100	PCT-MCLG
302	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
330	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
332	100	PCT-MCLG	100	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
334	100	PCT-MCLG	100	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
M400	32	PCT-MCLG	32	PCT-MCLG	0.25	ACH-HR	0.25	ACH-HR	100	PCT-MCLG
M510	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
M620	32	PCT-MCLG	32	PCT-MCLG	0.25	ACH-HR	0.25	ACH-HR	100	PCT-MCLG
800	0	CFM	0	CFM	0	CFM	0	CFM		
810	0	CFM	0	CFM	0	CFM	0	CFM		
M900	15	PCT-MCLG	15	PCT-MCLG	0.50	ACH-HR	0.50	ACH-HR	100	PCT-MCLG

Card 42---------------------- Fan SP and Duct Parameters-----------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
2	5.7		1			0.75	SUPPLY	OMIT			
3	6.6					0.75	SUPPLY				
4	5.5		0.8			0.75	SUPPLY	OMIT			
5	5.6					0.75	SUPPLY				
6	5.5					0.75	SUPPLY				
7	5.75		1			0.75	SUPPLY	OMIT			
8	2.5					0.75	SUPPLY				
9	2.5					0.75	SUPPLY				
10	2.8					0.75	OMIT				
11	2.0					0.75	SUPPLY				

.

Card 43------------------------ Airflow Design Temperatures ------------------------------

System Set Number	Minimum Cooling SADB	Maximum Cooling SADB	Minimum Heating SADB	Maximum Heating SADB	Minimum Cooling Lv DB	Maximum Cooling Lv DB	Minimum Preheat Lv DB	Maximum Preheat Lv DB	Minimum Room RH	Design Ht Rec Diff
2										
3										
4										
5									40	
6									40	

Card 44-- System Options --
--

System -- Set -- Number	Econ Type Flag	Econ On Point	Max Pct Outside Air	Direct Evap Cooling	Indirect Evap Cooling	1st Stage Evap Cooling	Fan Cycling	Exhaust Air Heat Recovery -- Effectiveness -- Stage 1	Stage 2	-- Control Type -- Stage 1	Stage 2	-- Exh-Side Deck Stage 1	Stage
2													
1	DRY-BULB	50	100										
2	DRY-BULB	50	100										
3	DRY-BULB	50	100										
4	DRY-BULB	50	100										
5													
6													
7	DRY-BULB	50	100										
8													
9													

← Economizer effectiveness increased to 100% of supply air

Card 45---------------------------------- Equipment Schedules -------------------------------------

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	AVAIL	AVAIL	NONE	NONE	NONE	AVAIL	AVAIL	AVAIL	NONE	NONE

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ---------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1			5000		AVAIL	

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	PKPLANT	1	7	11	11														
2	4	PKPLANT	8	8																
3	5	PKPLANT	9	9																

Card 62----------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001L	1	1000	TONS	0.64	KW-TON					1	PAR	
2	EQ1001L	1	1000	TONS	0.64	KW-TON					2	PAR	
3	THRMCHHE	1	000	TONS	1.07	COP					3	PAR	
4	EQ1307	1	20	TONS	1.38	KW-TON							
5	EQ1120L	1	90	TONS	1.3	KW-TON							

NEW CHILLERS RATED AT 0.64 KW/TON

Card 63----------------------------- Cooling Pumps and References ---------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	35	HP	125	HP					1	1
2	35	HP	125	HP					2	1
3	0	HP	0	HP					3	
5	5	HP								

SINGLE CW loop changed to primary/secondary

Card 64---------------------------- Cooling Equipment Options ---------------------------------

Cool Ref Num	Max CW Reset	Load Shed	Economizer	Evap Precool	Free Cooling Type	Heat Source	Cond Entering Temp	Cond Min Oper Temp	Cond Rej To Ref Type	Cond Rej To Ref Number	Cond Rej @ HW Temp
1							95	65			
2							95	65			
3							95	65			

Minimum condenser water temperature reduced to 65F

Card 65-- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	11																

Card 67-- Heating Equipment Parameters ---

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
2	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
3	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						

New boilers
80% efficiency

Card 69--------------------- Fan Equipment Parameters --------------------------

System Set Number	Cooling Fan	Heating Fan	Return Fan	Exhaust Fan	Auxiliary Supply	Room Exhaust	Optional Ventilation
1	EQ4001		EQ4004			SAMPLE-F	
2	EQ4001		EQ4004			SAMPLE-F	
3	EQ4001					SAMPLE-F	
4	EQ4001		EQ4004			SAMPLE-F	
5	EQ4001					SAMPLE-F	
6	EQ4001					SAMPLE-F	
7	EQ4001		EQ4004			SAMPLE-F	
8	EQ4001					SAMPLE-F	
9	EQ4001					SAMPLE-F	
10	EQ4001					SAMPLE-F	
11	EQ4000					EQ4000	

Card 70------------------- Fan Equipment KW Overrides ---------------------

	-----MAIN SYSTEM-----				--OTHER SYSTEM--			----DEMAND LIMIT PRIORITY---				
System Set Number	Cool Fan KW	Heat Fan KW	Ret Fan KW	Exh Fan KW	Aux Sup KW	Room Exh KW	Opt Vent KW	Cool Fan	Heat Fan	Aux Fan	Room Exh Fan	Opt Vent Fan
1	80		25									
2	80		25									
3	80											
4	100		13									
5	17											
6	33											
7	100		13									
8												
9												
10	16					60						
11												

Card 71---------------------------------- Base Utility Parameters --

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	DOM HOT WATER	11600	MBH	BLGBASE2	HOT-LD	1		60	140

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			0.07	KW-TON	T-WATER	CTOWER	2	50	15	PERCENT
2	EQ5100			0.07	KW-TON	T-WATER	CTOWER	2	50	15	PERCENT
3	EQ5100			0.00	KW	T-WATER	CTOWER	1	50	15	PERCENT

VSD's on cooling tower fans

Card 75-------------------------------------- Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5003	200	HP									

secondary CW pumps
with variable speed drives

Utility Description Reference Table

```
  Schedules:
       A-L8HPD  LIGHTS 8HR/DA
       A-MODSKF  KIT FAN MOD SCH
       A-P8HPD  PEOPLE 8HR/DA
       AVAIL  AVAILABLE (100%)
       BLGBASE2  HOSPITAL BLG TEMPLATE HOT WATER SCHEDULE
       CL_76  COOLING TSTAT - CONST 76F
       HOTRLGT  HOTEL ROOMS LIGHTS
       HT_75  HEATING TSTAT - CONST 75F
       NONE  ANY PROJECT
       OFF  ALWAYS OFF
  System:
       FC  FAN COIL
       FPVAV  FAN POWERED VAV
       PTAC  PACKAGED TERMINAL AIR COND.
       UV  UNIT VENTILATOR
       VRH  VARIABLE VOLUME REHEAT
  Equipment:
       Cooling:
            EQ1001L   2-STG CENTRIFUGAL CHILLER >550 TONS
            EQ1120L  AIR-CLD RECIPROCATING > 22 TONS
            EQ1307  PACKAGED TERMINAL AIR CONDITIONER
            THRMCHHE  TRANE DIRECT FIRED ABSORBER, 1.07 COP
       Heating:
            EQ2002  GAS FIRED STEAM BOILER
       Fan:
            EQ4000  PREVENTS CONSUMPTION OF FAN ENERGY
            EQ4001  AIR FOIL CENTRIFUGAL - CONSTANT VOLUME
            EQ4004  AXIAL FLOW - CONSTANT VOLUME (MODEL Q)
            SAMPLE-F  SAMPLE GENERIC FAN
            Tower:
                 EQ5100  COOLING TOWER FANS
          Misc:
             EQ5003  CHILLED WATER PUMP-VAV(SAME AS EQ5007)
```

Schedule Name: A-MODSKF
Project: KIT FAN MOD SCH
Location: EISENHOWER AMC
Client:
Program User:
Comments:

For ON/OFF SCH

Starting Month: JAN Ending Month: HTG
Starting Day Type: DSGN Ending Day Type: SUN

Hour	Util Percent
0	0
4	100
19	0
24	

RS&H

SUBJECT ______________________ AEP NO ____________
SHEET ______ OF ______
DESIGNER ____________________ DATE ____________
CHECKER _____________________ DATE ____________

Funded Modifications to H & C Plant and Hospital

Boiler Plant	Effect on Energy Use
New Firetube Boilers	Increase eff. fr. 68.5% → 80%
Remove Economizers	None
New BFW pumps, others	None
Chiller Plant	
New Centrifugal Chillers	0.65 kW/ton → 0.64 kW/ton
New CW Pumps & Dual Loop with VSD	Add Dual Loop & VSD
New Cooling Twrs and VSDs	Add VSDs on fans
Condenser Water Temp. Reset	Min. temp. from 80→65F
Absorption Chiller demand limiting	Not implemented since demand charge is minimal
Hospital HVAC System	
New OSA dampers, actuators	Increase econ. effect. 75%→100%
Scheduled Start/Stop & Optimum Start/Stop SF-1, SF-2	Cannot shut down SF-1 because of Emerg. or SF-2 because of labs
Hot deck & cold deck reset	Not implemented due to potential humidity problems
Kitchen Exhaust Sch'd s/s	Shut down 1900-0400

Other Mods -

T8 Lighting	25% reduction in lighting w/sf

RS&H

SUBJECT

AEP NO

SHEET OF

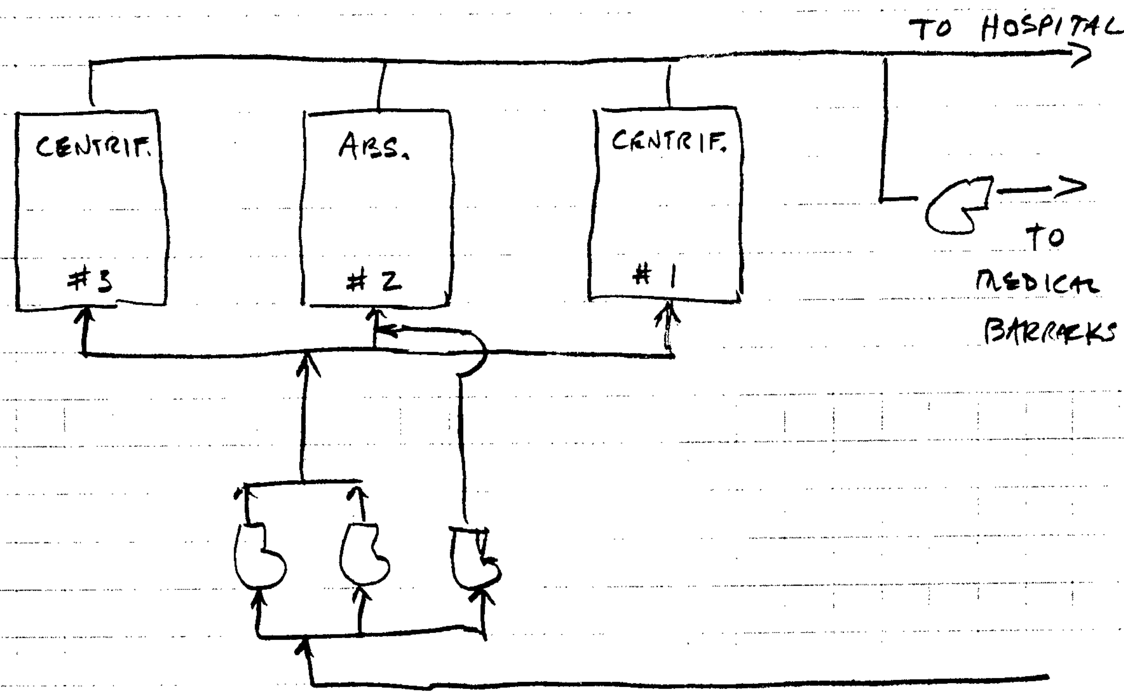
DESIGNER

DATE

CHECKER

DATE

CHILLED WATER SYSTEM



DATA LOG

	EVAP ΔP	COND ΔP	LVG T	S ΔT	W ΔT
#1 S	2-3 (92/94)[1]	16 (18/2)	41-42	10-13	5-7
#3 W	10 (62/72)[2]	12 (27/15)	42		
#3 S	2 (88/90)[2]	16 (18/2)	41		
#1 W	2 (64/66)	15 (18/3)	42		
DESIGN	7	10	42	12	9.4

[1] Also 72/74, 62/64

[2] Also 62/60

YORK. PRODUCT DRAWING

BorgWarner Air Conditioning P.O. Box 1592 York, PA 17405

Supersedes: Nothing

FORM 160.45-PA1.20 (585) (1 OF 20)

CODEPAK LIQUID CHILLERS UNIT DIMENSIONS & FLOOR LAYOUT MODELS YT A1 A1 B1 THRU YT L6 M6 F2 COOLING UNITS

CONTRACTOR Delta Ind. Cont.
ORDER NO. 0535
YORK CONTRACT NO. 5-21391
YORK ORDER NO. 85-816981

PURCHASER Delta Industrial Contractors
JOB NAME Replace Chillers Bldg. 310
LOCATION Ft. Gordon, Ga.
ENGINEER Gilley Consulting Engineers, Inc.

☐ REFERENCE DATE ____ ■ APPROVAL DATE 10/18/85 ☐ CONSTRUCTION DATE ____

PERFORMANCE SPECIFICATIONS:

CODEPAK

		COOLER	COND.	COMPR.	MOTOR	
MODEL	Y T	L 6	M 6	F 2 -	C B	C

NO. OF UNITS 2

DESIGN LOAD CONDITIONS PER UNIT, TONS 1050, SPEED CODE HJ, COOLING 2100 GPM OF water FROM 55 °F TO 43 °F, CONDENSER WATER 3150 GPM FROM 87.5 °F TO 96.9 °F. KW INPUT 680.

CONDENSER – WATER CIRCUIT, PASSES 2, DWP 150 PSIG. FOULING FACTOR .001. PRESS. DROP 23.6 FT. NOZZLE ARRANGEMENT – IN L OUT M.

COOLER – LIQUID CIRCUIT, PASSES 2, DWP 150 PSIG. FOULING FACTOR .0005, PRESS. DROP 15.8 FT. NOZZLE ARRANGEMENT – IN C OUT B.

MOTOR – POWER 4160 V, 3 PHASE, 60 HERTZ, FLA 106, LRA 742, INRUSH AMPS 742 WITH Across the line STARTING.

STARTER

☐ YORK SOLID STATE STARTER, REDUCED VOLTAGE, SOFT START, NEMA 1 ENCLOSURE, UNIT MOUNTED, INCLUDES CONTROL TRANSFORMER AND OIL PUMP POWER SUPPLY.

■ REMOTE ELECTRO-MECHANICAL STARTER PER YORK ENGINEERING STANDARD R-1051 (PRODUCT DRAWING 160.45-PA5.1), PURCHASED BY others, NEMA ____ ENCLOSURE, floor MOUNTED TYPE across the line. open TRANSITION.
OIL PUMP MOTOR (1 HP MAX.) REQUIREMENTS: FLA 2.3, VOLTS 460 3 PHASE, 60 HERTZ.
CONTROL POWER REQUIREMENTS: 1.5KVA, 115 VOLTS, 1 PHASE, 60 HERTZ.

OPTIONAL FEATURES AND REMARKS: Factory insulation of cooler, chilled water and condenser water fan switches. 1" thick neoprene insolation pads.

DIMENSIONAL REFERENCE CHART

UNIT MODEL	FIG. NO.	FLOOR LAYOUT FIG. NO.
~~YT A1 A1 B1 THRU YT E3 E3 B3~~	1	
~~YT B1 B1 C1 THRU YT E3 F3 C2~~	2	~~8~~
~~YT F1 E1 C1 THRU YT F3 F3 C2~~	3	~~8~~
~~YT G1 E1 E1 THRU YT J3 K3 E2~~	4	~~9~~
~~YT K1 J1 E1 THRU YT L3 K3 E2~~	5	~~8~~
~~YT K1 L1 E1 THRU YT L3 L3 E2~~	6	~~9~~
YT K4 J4 F1 THRU YT L6 M6 F2	7	~~10~~ 10

BD-3

Performance Data

Table 21-1 — Selection Data

Model	Chilled Water Flow Rate (GPM)	Chilled Water Pr.Drop (Feet)	Hot Water Flow Rate (GPM)	Hot Water Pr.Drop (Feet)	Cond./Abs. Water Flow Rate (GPM)	Cond./Abs. Water Pr.Drop (Feet)	Combustion Air (CFM)	Exhaust Gas (CFM)	Aux. Power (KW)	Aux. Power (KVA)
ABDL-100	230	12.6	219	11.4	423	16.2	250	410	4.4	24.3
ABDL-120	276	12.3	266	11.4	507	24.7	300	490	4.9	25.3
ABDL-150	346	13.5	332	12.5	635	18.6	380	620	5.3	28.5
ABDL-180	415	15.1	397	13.9	762	28.3	450	740	6.7	34.3
ABDL-200	461	10.6	441	9.8	847	20.1	500	820	7.5	39.5
ABDL-240	553	10.9	529	10.0	1014	30.4	600	990	8.2	40.7
ABDL-300	691	15.2	660	13.9	1270	23.5	750	1230	10.4	47.0
ABDL-350	806	10.1	769	9.3	1482	12.8	870	1440	10.4	47.0
ABDL-400	922	11.4	879	10.5	1693	17.4	1000	1640	11.1	47.0
ABDL-450	1037	15.4	992	14.2	1905	22.9	1120	1850	11.5	49.0
ABDL-500	1152	20.1	1101	18.6	2117	29.5	1240	2050	11.5	42.5
ABDL-550	1267	25.8	1210	23.7	2328	37.2	1370	2260	13.0	49.0
ABDL-600	1382	18.7	1318	17.1	2540	25.6	1490	2460	18.6	73.6
ABDL-700	1613	26.6	1538	24.5	2963	36.0	1740	2870	21.9	73.6
ABDL-800	1843	13.4	1758	12.2	3387	28.6	1990	3280	23.8	80.5
ABDL-900	2074	17.5	1977	16.1	3810	37.2	2240	3690	27.5	96.6
ABDL-1000	2304	10.5	2197	12.2	4233	18.6	2490	4100	32.7	105.6
ABDL-1100	2534	13.4	2417	12.2	4657	23.1	2740	4510	32.7	105.6

Notes:
1. Based upon the following conditions:
cooling duty: 54-44 F chilled water, 85-95 F condenser water, std. fouling factors.
heating duty: 130-140 F hot water, std. fouling factor.
2. Auxiliary power includes the electrical power consumption of the following components:
refrigerant pump, solution pumps, burner fan, control power, palladium cells.

Table 21-2 — Water Flow Rates

Model	Flow Rate Limitations' Std. Evaporator Min (GPM)	Std. Evaporator Max (GPM)	Hi Eff. Evaporator Min (GPM)	Hi Eff. Evaporator Max (GPM)	Condenser/Absorber Min (GPM)	Condenser/Absorber Max (GPM)	System Water Capacity Evap. (Gal.)	System Water Capacity Cond/Abs. (Gal.)
ABDL-100	152	383	152	383	302	528	29	71
ABDL-120	185	383	185	383	365	528	34	82
ABDL-150	218	511	218	511	432	889	40	95
ABDL-180	248	511	248	511	488	889	48	111
ABDL-200	334	766	334	766	658	1057	53	119
ABDL-240	396	766	396	766	785	1057	61	140
ABDL-300	410	806	410	806	813	1457	82	293
ABDL-350	595	1220	595	1220	1185	2166	90	325
ABDL-400	638	1220	638	1220	1268	2166	100	357
ABDL-450	608	1220	608	1220	1209	2166	108	388
ABDL-500	584	1466	584	1466	1157	2453	122	428
ABDL-550	562	1466	562	1466	1118	2453	129	460
ABDL-600	734	1933	628	1625	1498	2778	291	608
ABDL-700	707	1933	605	1951	1438	3329	317	634
ABDL-800	1163	2902	1004	2439	2394	3840	370	766
ABDL-900	1130	2902	971	2439	2310	4166	396	819
ABDL-1000	1542	3809	1417	3201	3377	5517	449	1110
ABDL-1100	1602	3809	1374	3201	3273	5517	476	1136

BD-4

FAMILY PRACTICE

AIR COOLED CHILLER

MARK	LOCATION	CAPACITY	EVAPORATOR				CONDENSER			COMPRESSOR			
			EWT °F	LWT °F	GPM	MAX. P.D.	AMB. °F	FAN HP	VOLTS/Ø	NO.	MIN. UNIT EER	VOLTS/Ø	UNLOA % STE
CH-1	MECH COURTYARD	188.6 TON	55	45	232	12	97	12@1.0	460/3	2	9.3	460/3	100-83-67-
													33-17

① LOW AMBIENT OPERATION TO 0° F

20% glycol

STEAM CONVERTOR

MARK	SERVES	GPM	WPD FT	EWT F	LWT F	STEAM PSI	DIA IN	LENGTH IN	PASS	REMARKS
CO-1	HEAT LOOP	65	4.7	160	180	2	8	48	4	

EXPANSION TANK

MARK	TANK VOLUME	ACCEPT VOLUME	TYPE	LOCATION	REMARKS
XT-1	68	34	DIAPH	FP130	CHILL WATER LOOP
XT-2	110	34	DIAPH	FP086	HEAT WATER LOOP

CONDENSATE RETURN UNIT

MARK	RECIEVER GAL.	CAPACITY	PUMP						REMARKS
			NO	GPM	PSI	HP	RPM	VOLTS/Ø	
CRU-1	15	2000 FT²	2	3	40	3/4	3500	115/1	
		EDR							

EXHAUST FANS

MARK	SERVES	CFM	SP IN.	RPM	HP	VOLTS/Ø	MAX SONES	DRIVE	TYPE	REMARKS
EF-1	FP123	325	0.5	992	1/6	115/1	5.7	BELT	CENT RF	①
EF-2	FP053	665	0.5	1083	1/6	115/1	6.4	BELT	CENT RF	①
EF-3	FP041	85	0.5	1436	1/6	115/1	2.6	DIRECT	CENT RF	①②
EF-4	FP017	85	0.5	1436	1/6	115/1	2.6	DIRECT	CENT RF	①②
EF-5	FP001	410	0.5	1013	1/6	115/1	5.9	BELT	CENT RF	①
EF-6	FP085	80	0.5	1429	1/25	115/1	2.6	DIRECT	CENT RF	①②
EF-7	FP092	380	0.5	1006	1/6	115/1	5.9	BELT	CENT RF	①
EF-8	FP118	545	0.5	1050	1/6	115/1	6.2	BELT	CENT RF	①

① CURB, BIRD SCREEN, DISCONNECT, GRAVITY BACKDRAFT DAMPER.
② VARIABLE SPEED CONTROLLER, SOLID STATE

RS&H.

SUBJECT

DESIGNER

CHECKER

AEP NO

SHEET OF

DATE

DATE

Centrifugal Chiller Test

10AM 10/26/95 CHWS = 44.2F / 59 psig

OAT = 77°F CHWR = 53.5F / 61 psig

FLA = 95% ΔT = 9.3 F / ΔP = 2 psig

Design Conditions

CHW ΔP = 15.8 ft GPM = 2100 ΔT = 12 F

= 6.9 psi

CNW ΔP = 23.6 ft GPM = 3150 ΔT = 94F

10.3 psi

KW input = 680

$$\frac{kw}{ton} = \frac{680}{\underbrace{2100 * 12 * 500}_{12{,}000}} = \frac{680}{1050} = 0.65 \frac{kw}{ton}$$

$F^2 \propto P$

$F \propto \sqrt{P}$

RS&H

SUBJECT

DESIGNER Hutchins

CHECKER

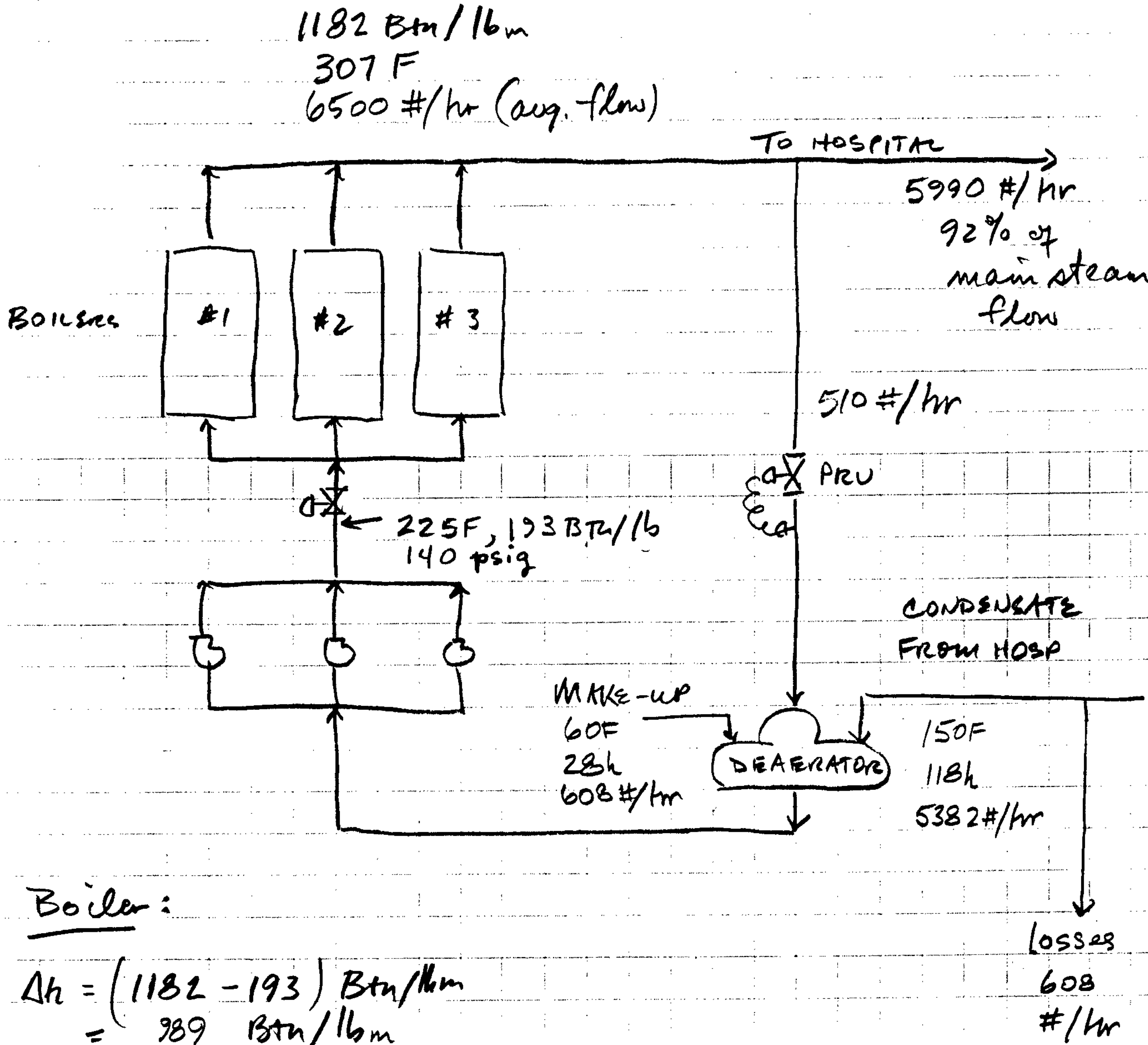
AEP NO

SHEET ____ OF ____

DATE 1/9/96

DATE

BOILER PLANT SYSTEM



Boiler:

$$\Delta h = (1182 - 193)\ \text{Btu/lbm}$$
$$= 989\ \text{Btu/lbm}$$

TO

GENERATOR DATA

CAPACITY [POUNDS STEAM/HOUR AT OPERATING CONDITIONS]--15,400

SITE LOCATION---FORT GORDON, GA.

DESIGN PRESSURE [PSIG]--150

OPERATING PRESSURE [PSIG]-------------------------------------125

STEAM TEMPERATURE--SATURATED

FEEDWATER TEMPERATURE [DEGREES F.]----------------------212° F.

EFFICIENCY AT CONTINUOUS CAPACITY----------------78.0% GAS/82.0% OIL

STEAM QUALITY--99.5%

TOTAL HEATING SURFACE [SQ. FT.]-------------------------*2,010

RADIANT HEATING SURFACE [SQ. FT.]-----------------------*232

FURNACE VOLUME [CU. FT.]--------------------------------------345

DRAFT LOSS---1.2" W. C.

HEAT RELEASE RATE:

BTU/HR./CU. FT. FURNACE VOLUME---------OIL FIRED------54,440
GAS FIRED------57,220

OPERATING WEIGHT---46,800 POUNDS

SHIPPING WEIGHT--37,250 POUNDS

GENERATOR DIMENSIONS

OVERALL WIDTH---10' - 6"

OVERALL HEIGHT TO STEAM OUTLET FLANGE-------------------12' - 8"

OVERALL LENGTH [INCLUDING BURNER & FAN]------------------14' - 0"

FLUE GAS OUTLET----------------------WIDTH 18"--------HEIGHT 6'-0"

*Revised 12/15/71

Eisenhower Army Medical Center
Fort Gordon Augusta, GA
Boiler Performance Analysis
Filename: BOIL.WK4

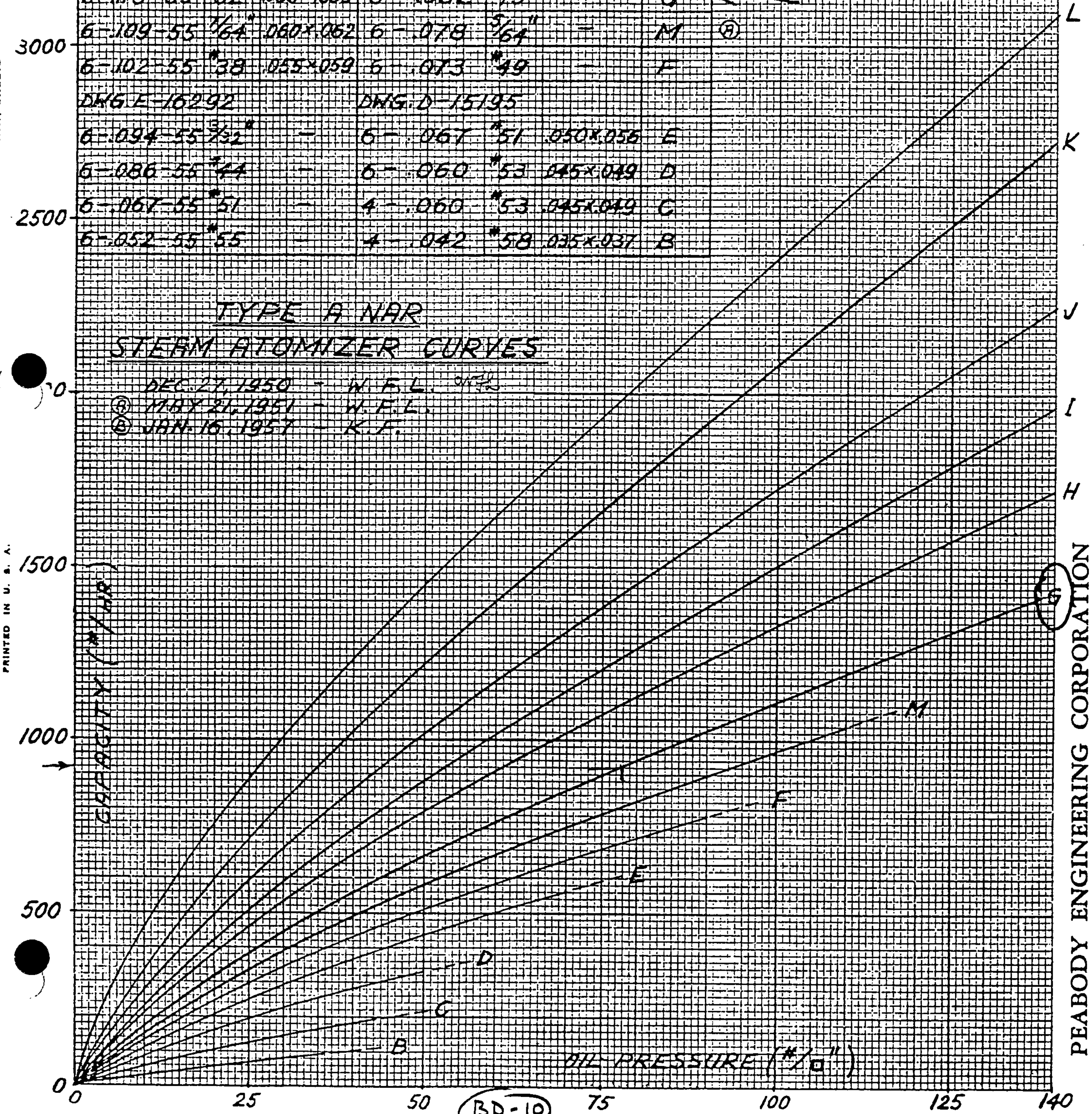
12/01/95

Day of Week	Time	Outside Temp. (F)	Steam Flow (klbs/hr)	Gas Use (kcf/hr)	Fuel Use Eff (%)	Make-up water (gals)	Make-up water (lbs)	Make-up water (%)
T	10/25/94	79	162	106	146.0	2000	16600	10.2
W	10/26/94	69	185	137	129.0	2500	20750	11.2
R	10/27/94	69	210	148	135.6	800	6640	3.2
F	10/28/94	57	215	177	116.0	1100	9130	4.2
S	10/29/94	55	190	159	114.2	1300	10790	5.7
N	10/30/94	64	175	151	110.7	1200	9960	5.7
M	10/31/94	72	143	133	102.7	1100	9130	6.4
W	1/18/95	54	217	291	71.2	2440	20252	9.3
R	1/19/95	55	226	292	73.9	2306	19139.8	8.5
F	1/20/95	43	233	308	72.3	1800	14940	6.4
S	1/21/95	41	224	279	76.7	1400	11620	5.2
N	1/22/95	43	240	300	76.4	1140	9462	3.9
M	1/23/95	40	232	294	75.4	1000	8300	3.6
T	1/24/95	37	269	344	74.7	1100	9130	3.4
M	04/10/95	75	142	202	67.2	0	0	0.0
T	04/11/95	70	143	203	67.3	0	0	0.0
W	04/12/95	72	133	216	58.8	2500	20750	15.6
R	04/13/95	72	147	291	48.3	0	0	0.0
F	04/14/95	68	166	296	53.6	0	0	0.0
S	04/15/95	68	165	220	71.7	0	0	0.0
N	04/16/95	71	157	212	70.8	0	0	0.0
S	07/01/95	75	91	124	70.1	2200	18260	20.1
N	07/02/95	78	83	114	69.6	1500	12450	15.0
M	07/03/95	79	87	122	68.1	1700	14110	16.2
T	07/04/95	79	85	117	69.4	1900	15770	18.6
W	07/05/95	84	84	126	63.7	2600	21580	25.7
R	07/06/95	85	84	118	68.0	2800	23240	27.7
F	07/07/95	82	85	119	68.2	2300	19090	22.5

TIP			PLUG			DESIGNATION	
SIZE	HOLES	SLOTS	SIZE	HOLES	SLOTS		
DWG. D-13986		W. D.	DWG. D-14096		W. D.		
5-.188-55	5/16"	.105×.105	5-.128	#30	–	L	
6-.159-55	#21	.090×.090	6-.113	#33	–	K	
6-.144-55	#27	.080×.082	6-.104	#37	–	J	
6-.136-55	#29	.075×.077	6-.096	#41	–	I	
6-.125-55	1/8"	.070×.072	6-.089	#43	–	H	
6-.116-55	#32	.065×.065	6-.082	#45	–	G	←
6-.109-55	7/64"	.060×.062	6-.078	5/64"	–	M	Ⓐ
6-.102-55	#38	.055×.059	6-.073	#49	–	F	
DWG E-16292			DWG. D-15195				
6-.094-55	3/32"	–	6-.067	#51	.050×.056	E	
6-.086-55	#44	–	6-.060	#53	.045×.049	D	
6-.067-55	#51	–	4-.060	#53	.045×.049	C	
6-.052-55	#55	–	4-.042	#58	.035×.037	B	

TYPE A NAR
STEAM ATOMIZER CURVES

DEC. 27, 1950 – W.F.L.
Ⓐ MAY 21, 1951 – W.F.L.
Ⓑ JAN. 16, 1957 – K.F.



PEABODY ENGINEERING CORPORATION

BD-10

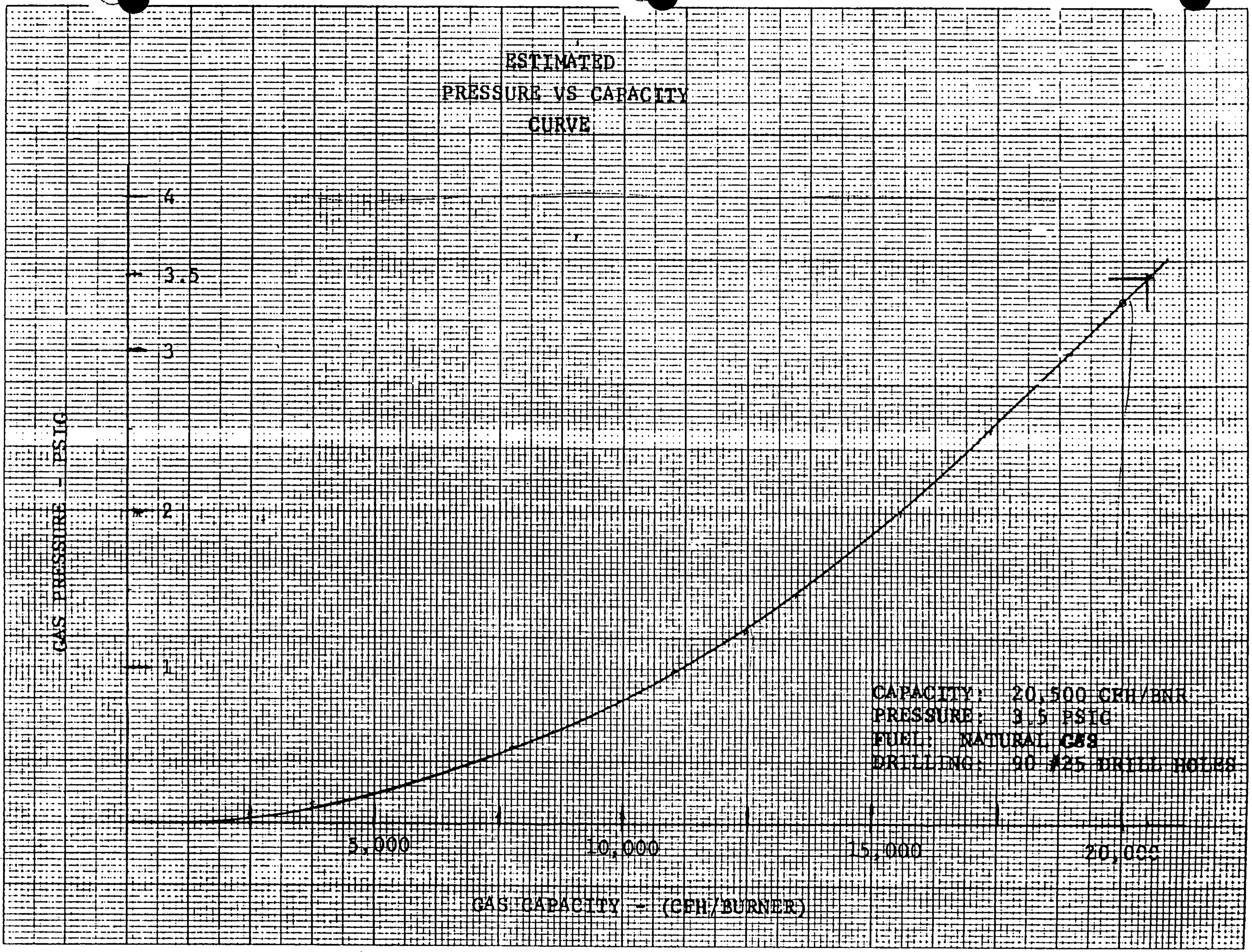
DATA SHEETS

20 X 20 to the inch PRINTED IN U. S. A.

CE-17372-B

NO. 15TR - 20L GRAPH PAPER 20 X 20 PER INCH

VISIGRAPH MADE IN U.S.A.



BD-11

RS&H

SUBJECT ______ AEP NO ______

SHEET ______ OF ______

DESIGNER Hutchins DATE 12/5/95

CHECKER ______ DATE ______

SPACE	Ht (ft)	DIMENSIONS (ft)		FLOOR SPACE (SF)	TRACE 600
Penthouse (14th)		50 x 225		11,250	
6th-13th	11.5	90 x 300	27,000 X8 =	216,000	
5th	15.0'	77 X 300	20,720	23,100 ✓	25,000
4th	15.0'	74 X 300	22,200	22,200	
3rd	16.5'	400 x 300	120,000	120,000	116,750
2ND	16.5'	400 x 300	120,000	120,000	113,250
1ST	16.5'	400 x 221	88,400	88,400	89,000

North elevation: 2ND at ground level — 600,950

South elevation: 3rd at ground level

Actual = 601,933

MRI	2940 ✓
FAMILY PRACTICE	25,976 ✓
	629,866
MEDICAL BARRACKS	102,776 ✓
	732,642

POPULATION DENSITY $\frac{629,866 - 11,250}{2000} = \frac{309 \text{ sf}}{\text{pers}}$

PEAK DAY

NIGHT = 400 people

RS&H

SUBJECT ______________________

DESIGNER ______________________

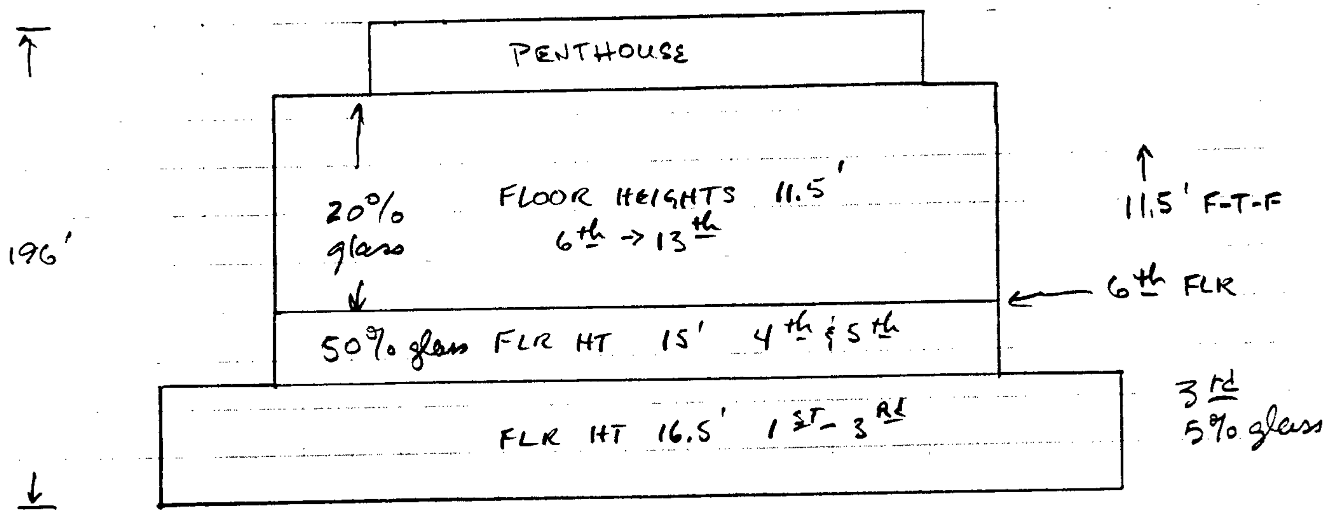
CHECKER ______________________

AEP NO ______________

SHEET ______ OF ______

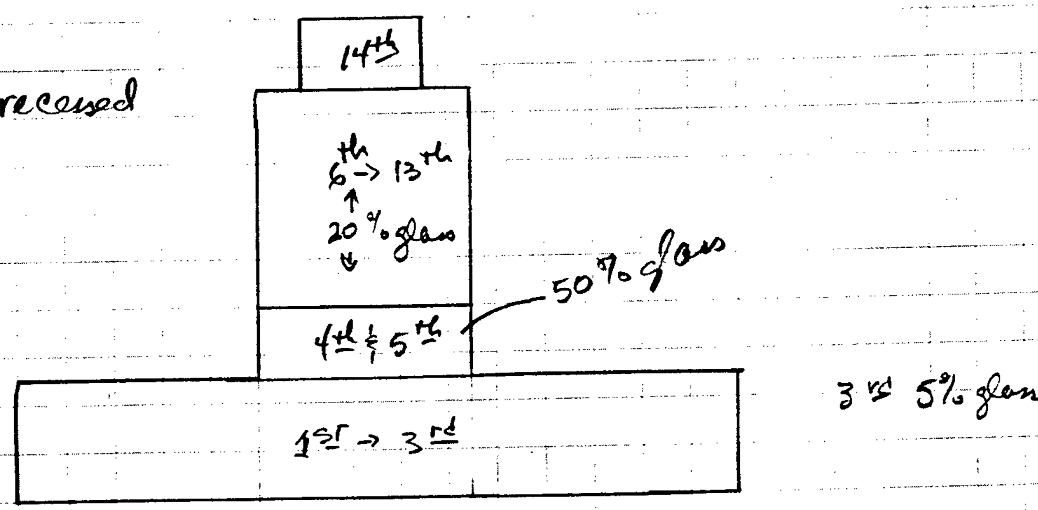
DATE ______________

DATE ______________



NORTH ELEVATION

Glass recessed 2.5'



EAST ELEVATION

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SUBJECT ______________________

DESIGNER ______________________

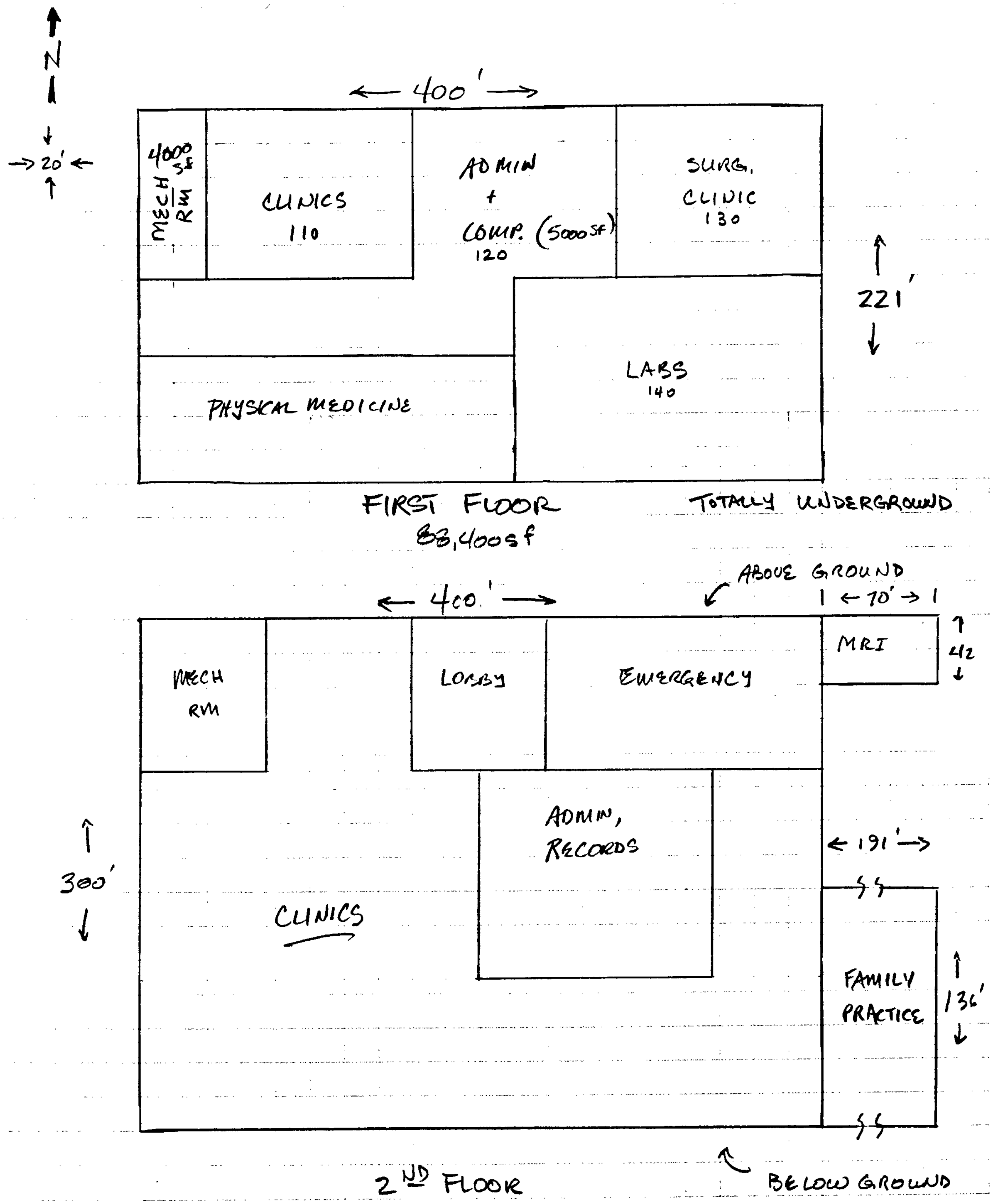
CHECKER ______________________

AEP NO ______________________

SHEET ________ OF ________

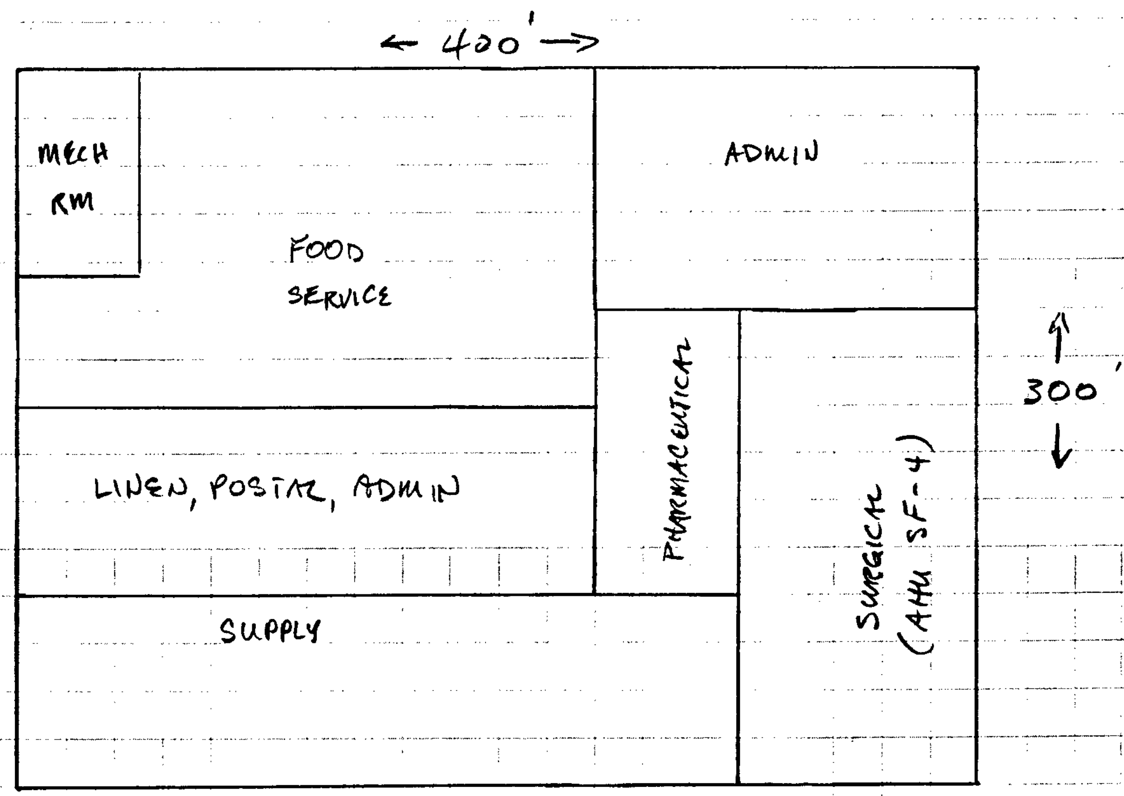
DATE ______________________

DATE ______________________

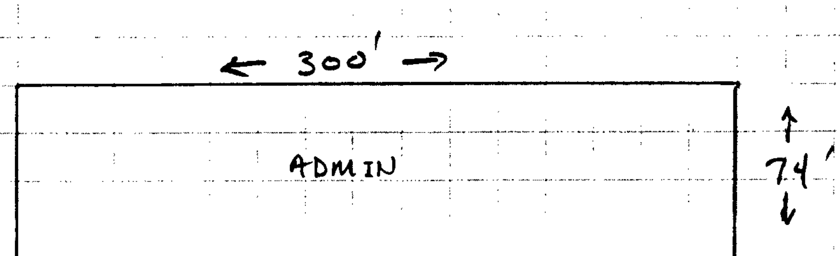


RS&H

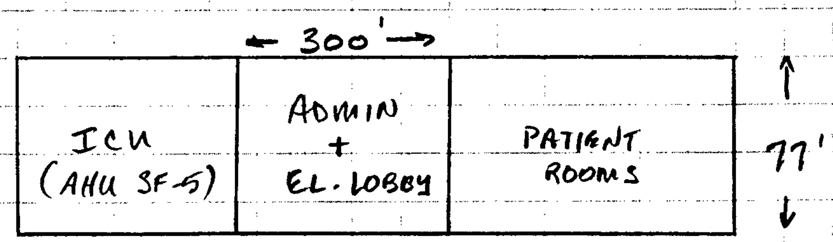
SUBJECT ______ AEP NO ______
SHEET ______ OF ______
DESIGNER ______ DATE ______
CHECKER ______ DATE ______



3rd Floor (Served by SF-3 and SF-4)



4th FLOOR



5th FLOOR

2200 sf for stairs & elev. each floor

FLR SPACE

PATIENT	ADM	ICU
9200	7000	6900

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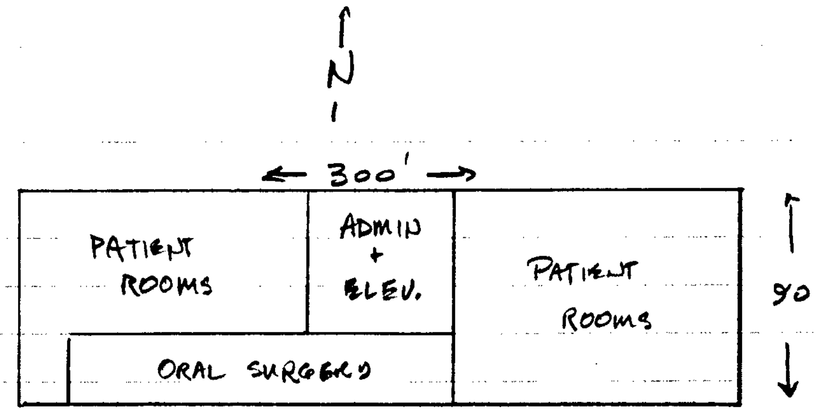
SUBJECT ____________________ AEP NO ____________

SHEET ________ OF ________

DESIGNER ____________________ DATE ____________

CHECKER ____________________ DATE ____________

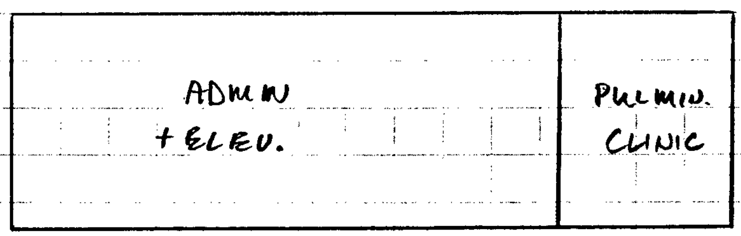
SF-5 SERVES ORAL SURGERY AND PART OF PATIENT AREA IN WESTERN HALF OF 6th



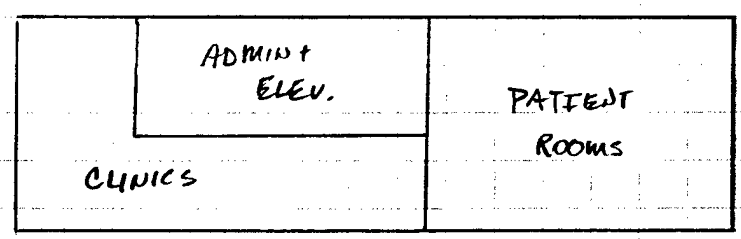
6th FLOOR

	PATIENT	OTHER
6th FLOOR	18,600	8400

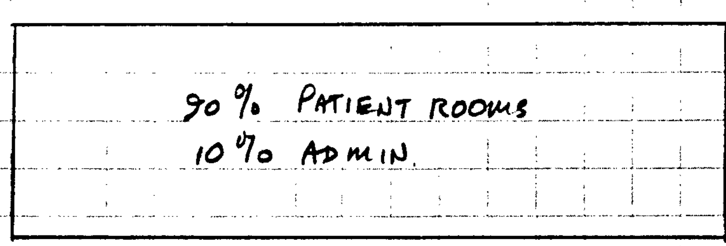
7-13 FLOOR SPACE



7th FLOOR



8th FLOOR



9th FLOOR

	PATIENT	OTHER
7th FLOOR	0	27,000
8th FLOOR	11,700	15,300
9th FLOOR	24,300	2700

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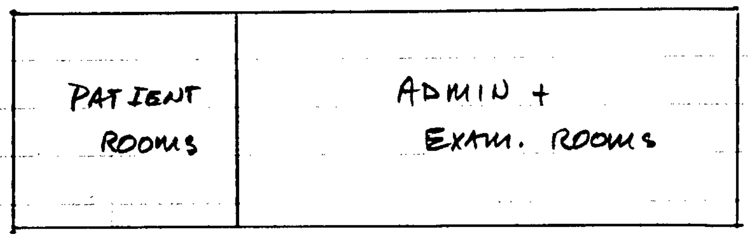
SUBJECT ____________________
DESIGNER ____________________
CHECKER ____________________

AEP NO ____________________
SHEET ________ OF ________
DATE ____________________
DATE ____________________

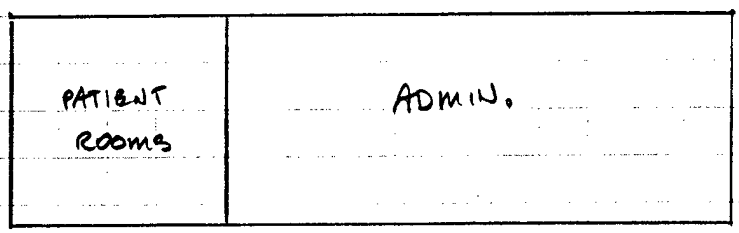
7-13
FLOOR SPACE

PATIENT OTHER



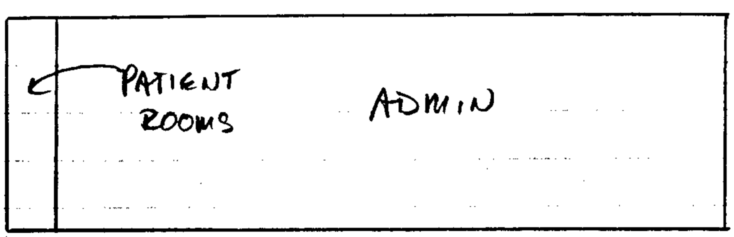
10th FLOOR

8100 18,900



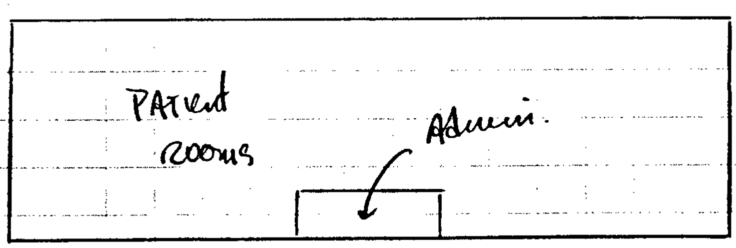
11th Floor

8100 18,900



12th Floor

1800 25,200



13th FLOOR

25,800 1200

	PATIENT	OTHER
Σ FLR 7-13	79,800	109,200
AVG PER FLR	11,400	15,600
%	42%	58%

BD-17

RS&H

SUBJECT ______________________

DESIGNER ______________________

CHECKER ______________________

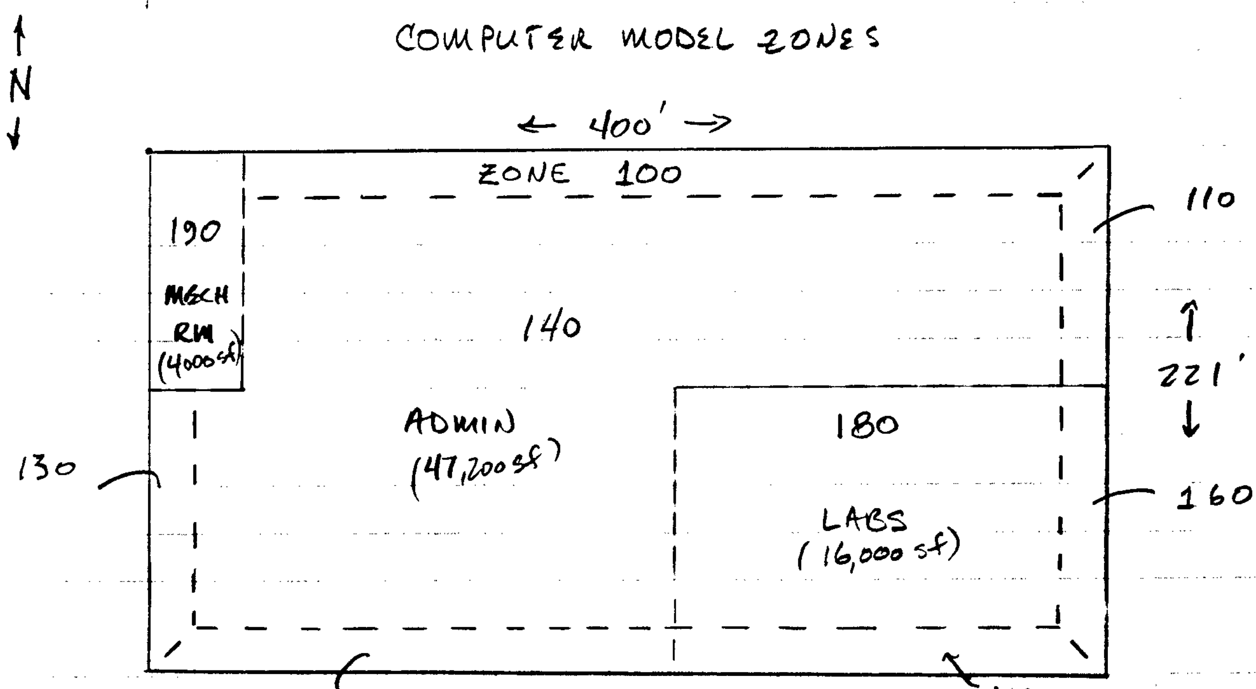
AEP NO ______________________

SHEET ________ OF ________

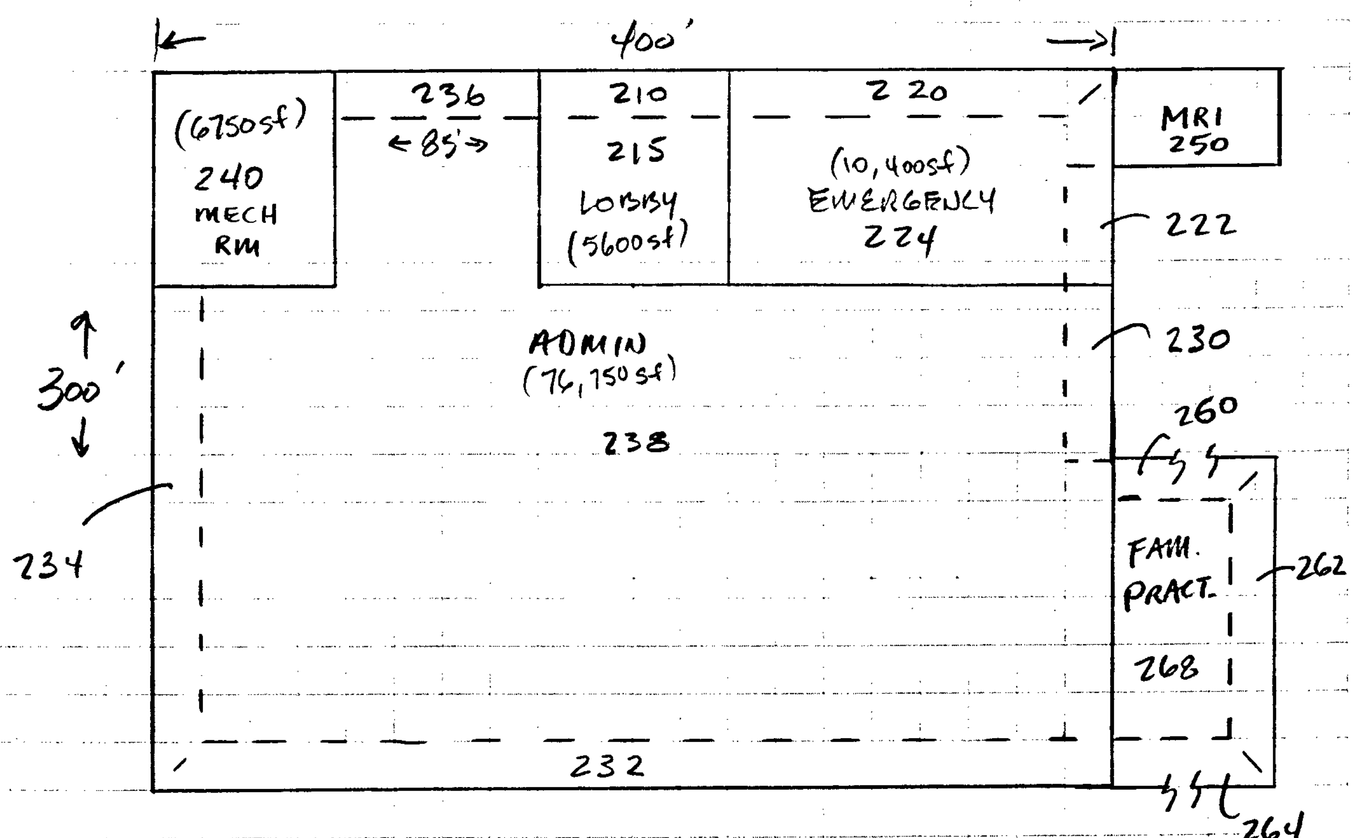
DATE ______________________

DATE ______________________

COMPUTER MODEL ZONES



FIRST FLOOR



2ND FLOOR

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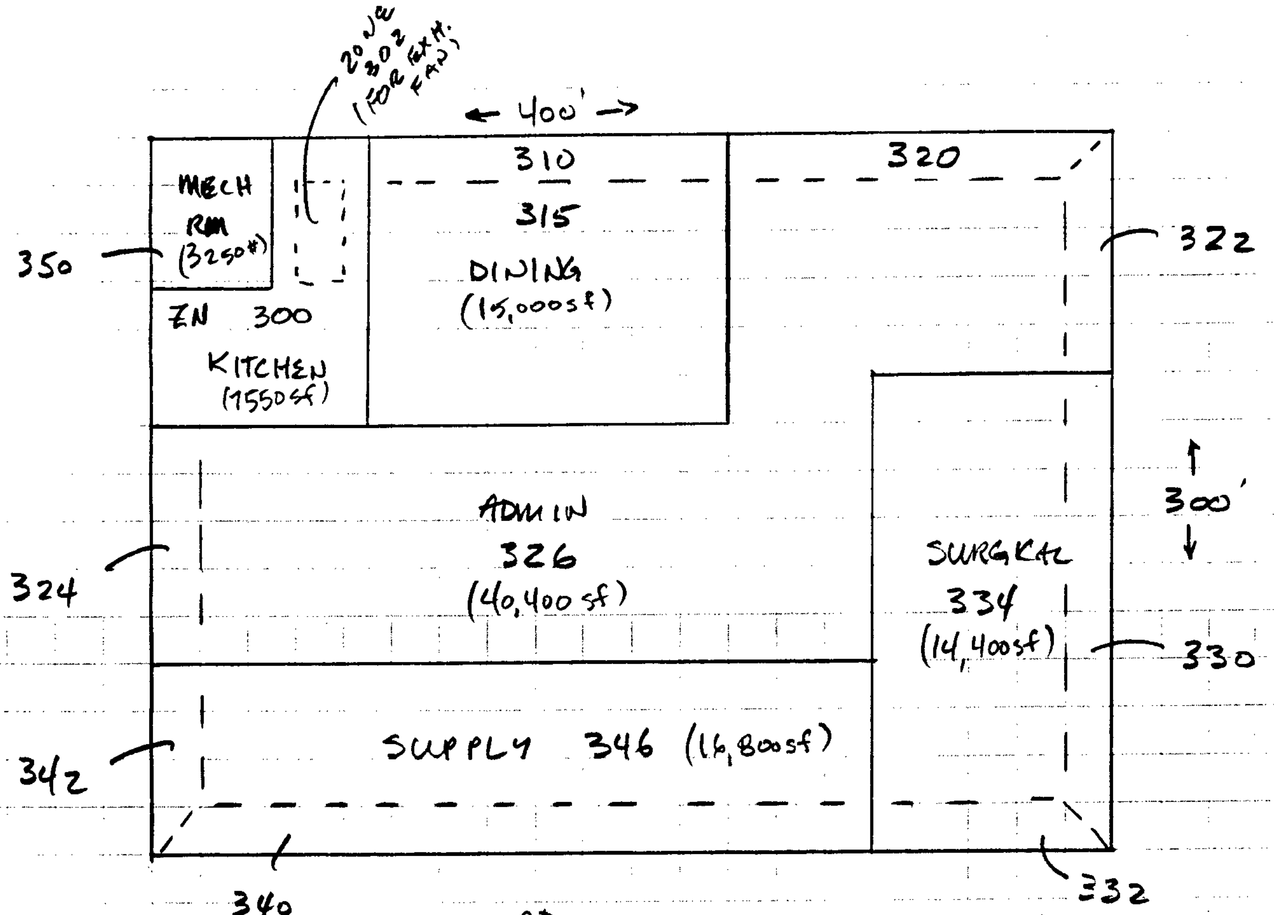
SUBJECT ______________________ AEP NO ____________

______________________ SHEET ______ OF ______

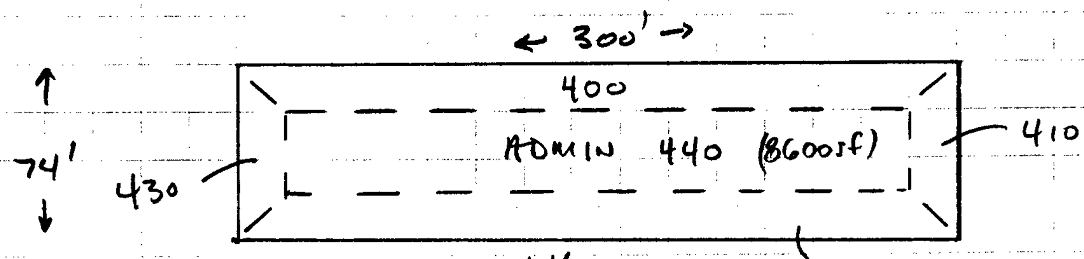
DESIGNER ______________________ DATE ____________

CHECKER ______________________ DATE ____________

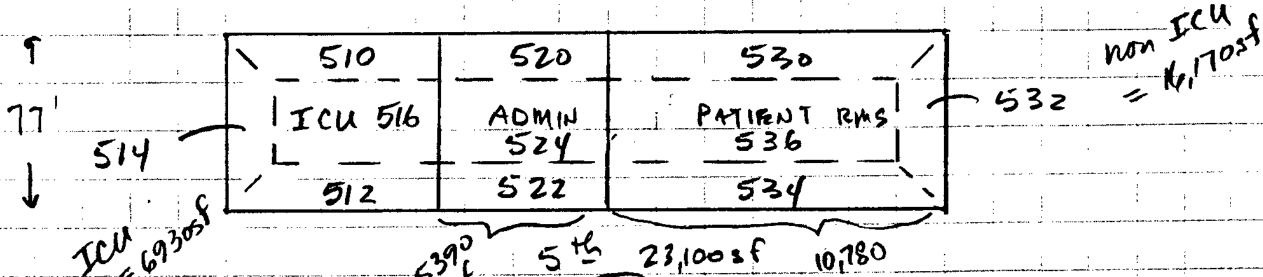


3rd FLOOR
120,000sf

East - 6800
West - 15,400
22,200



4th FLOOR
22,000 sf



5th 23,100sf

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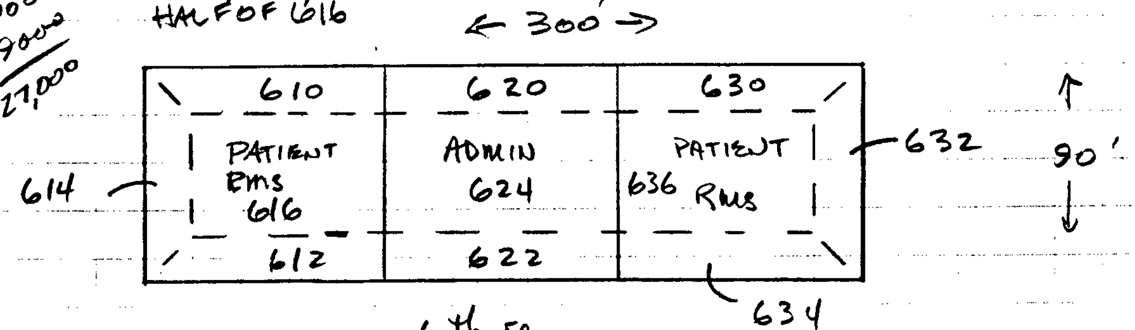
SUBJECT
DESIGNER
CHECKER

AEP NO
SHEET OF
DATE
DATE

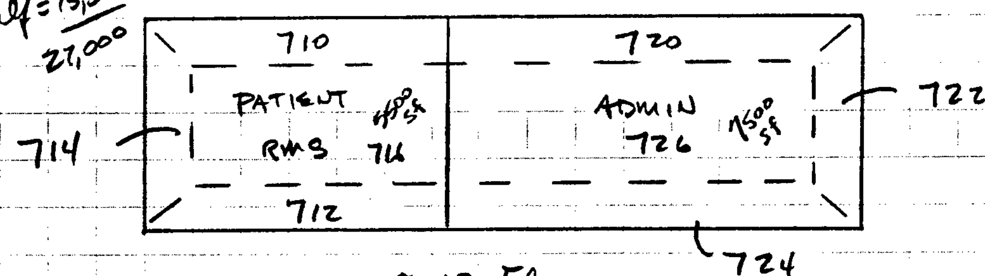
SF-5
Serves
622 612
HALF OF 616

east - 9000
mid - 9000
west - 9000
27,000

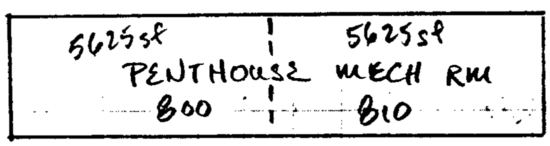


6th Floor
27,000sf

west half = 11,700
east half = 15,300
27,000



7-13 Floors
27,000 sf each



11,250sf

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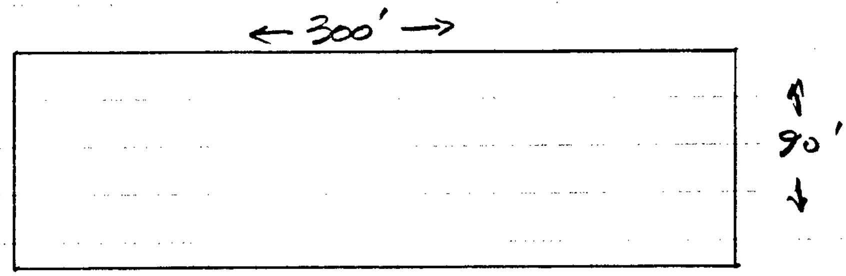
SUBJECT ______________________ AEP NO ______________

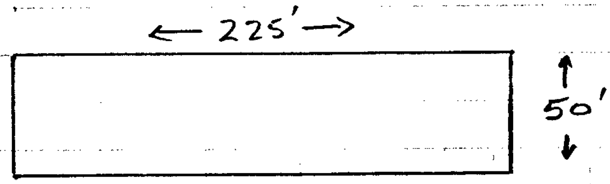
______________________ SHEET ________ OF ________

DESIGNER ______________________ DATE ______________

CHECKER ______________________ DATE ______________



6th → 13th FLOOR



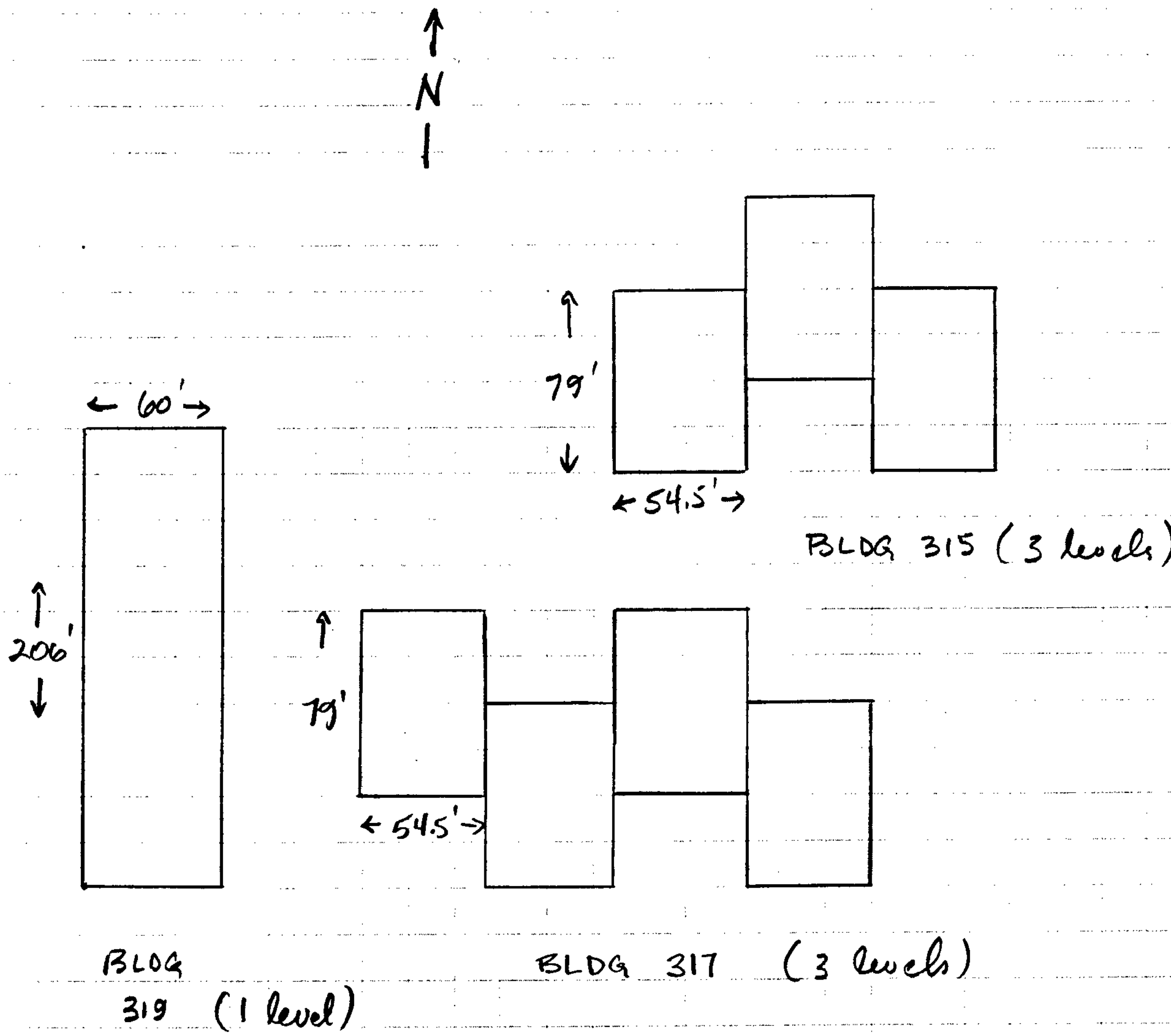
14th FLR (non conditioned mechanical room)

RS&H

SUBJECT
DESIGNER Hutchins
CHECKER

AEP NO
SHEET OF
DATE 12/6/95
DATE

MEDICAL BARRACKS COMPLEX



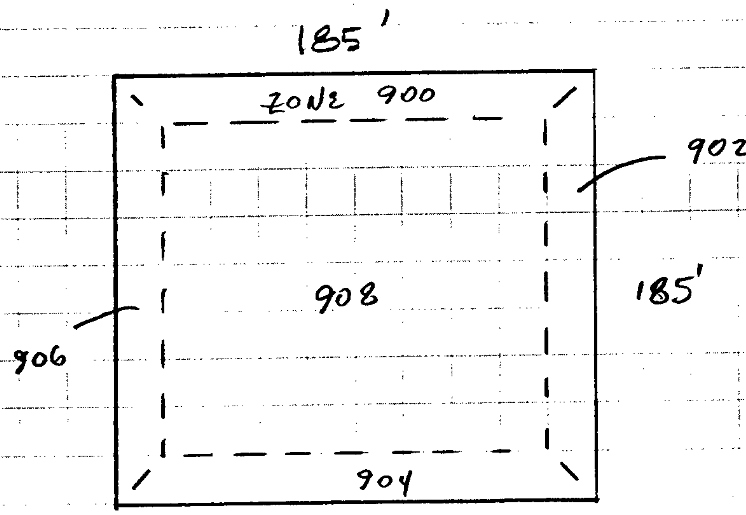
BLDG	FLOOR AREA	WALL AREA	ROOF AREA
315	38,750	19,050	12,917
317	51,666	24,630	17,222
319	12,360	6384	6384
TOTAL	102,776	50,064	36,523

RS&H

SUBJECT ______
DESIGNER Hutchins
CHECKER ______

AEP NO ______
SHEET ______ OF ______
DATE 12/6/96
DATE ______

MEDICAL BARRACKS COMPLEX
COMPUTER MODEL



3 FLOORS

F-T-F HT = 22.6'
TOTAL HT = 67.8'

AREAS

FLOOR	WALL	ROOF	
102,675	50,172	36,500	(185' x 197')

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SUBJECT

DESIGNER Hutchins

CHECKER

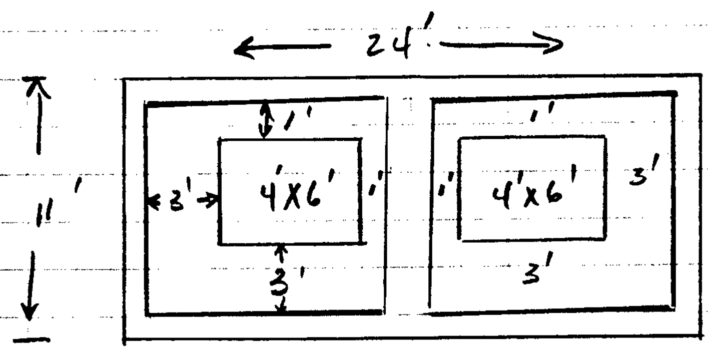
AEP NO

SHEET OF

DATE 1/29/96

DATE

Typical Exterior Window/Wall



% Window $\frac{4 \times 6}{11 \times 24} = 0.091$

RS&H.

SUBJECT
DESIGNER
CHECKER
AEP NO
SHEET OF
DATE
DATE

TRACE 600 INPUT

AREA	Systems		EAMC AHU	SERVES
88,400 ✓	1	TRH	1	FLR 1
120,000 ✓	2	"	2	FLR 2
97,000 ✓	3	"	3	FLR 3 (exc Surgical & kitchen make up)
128,525 ✓	4	"	4A	FLRS 4-13 EAST (EXC 5th ICU & part of 6th)
14,730 ✓	5	"	5	FLR 5 ICU & PART OF 6th
20,000 ✓	6	"	3	SURGICAL
129,295 ✓	7	"	4B	FLRS 4-13 WEST
2940 ✓	8	DX	–	MRI
25,976 ✓	9	PPVAV	-	FAMILY PRACTICE
3000 ✓	10	UV	-	KITCHEN MAKE UP
102,675 ✓	11	FC	-	MEDICAL BARRACKS
732,541				

RS&H

SUBJECT

DESIGNER

CHECKER

AEP NO

SHEET OF

DATE

DATE

Attu Capacities

SF-#	TRACE #	DESIGN
1	1	813
2	2	
3	3	
4A	4	297
5	5	108
6	6	210
4B	7	297
		1725

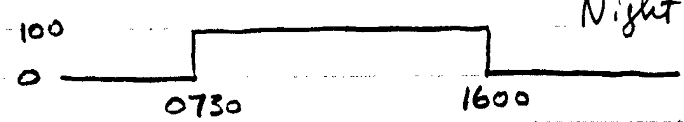
RS&H

SUBJECT ______________________ AEP NO ______________
DESIGNER ______________________ SHEET ________ OF ________
CHECKER ______________________ DATE ______________
DATE ______________

Schedules

AVAIL - 24 h/day

People - 8 HPD - 7:30 - 4:00   Day 2000 people
Night 400 people



1 ST Flr - Labs 24 h/d, all else 8 HPD

2 ND Flr - Radiology, Emerg, Info desk 24 HPD
all else 8HPD

3 RD Flr - SICU, Pharmacy, CMS (Sterilization)
24 HPD - all else 8 HPD

4 th Flr - 8 HPD

Lighting - follows people schedule, but minimum level is 0.25

Misc.
Equipment - same as lighting

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SUBJECT

DESIGNER

CHECKER

AEP NO

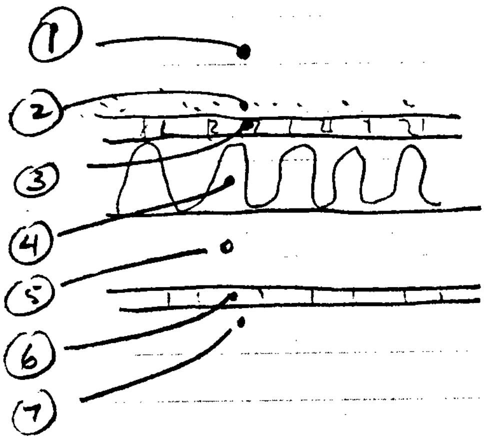
SHEET OF

DATE

DATE

TRACE CONSTRUCTION
CODE = 162

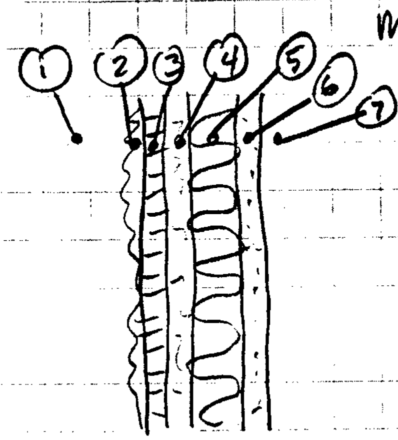
MRI ROOF



		R	TRACE CODE
1	Outside air	0.17	F1
2	B/U Roof	0.33	F7
3	5/8" Plywood	0.78	F2
4	6" Batt insul.	20.00	B6
5	Airspace	0.91	B0
6	Acoustical tile	1.90	F17
7	Inside air film	0.61	F21

U = 0.04 ΣR = 24.70

MRI EXT. WALL TCC = 163



1	Outside air	0.17	F1
2	Stucco	0.21	A1
3	1" Quick R-Board	4.53	F14
4	5/8" Plywood	0.78	F2
5	3½" Insul	11.00	F3
6	Gypsum Bd	0.45	F16
7	Inside air film	0.68	F5

U = 0.056 ΣR = 17.82

********** CUSTOMER DIRECT SERVICE NETWORK **********

For exclusive use by: REYNOLDS SMITH & HILLS

T R A N S F E R   F U N C T I O N   L I S T I N G

160 - HOSPITAL ROOF U=0.058

LAYER CODE	DESCRIPTION	THICKNESS (INCHES)	CONDUCT (B/HR-FT-F)	DENSITY (LB/CF)	SP HEAT (B/LB-F)	RESISTANCE (SF-HR-F/B)
F1	OUTSIDE AIR FILM	.00	.000	.0	.000	.170
F7	BUILT-UP ROOFING	.38	.094	70.0	.350	.333
F14	RIGID BOARD INSULATI	1.44	.026	.6	.200	4.528
C1	4" L.W. CONCRETE	4.00	.100	40.0	.200	3.333
C2	6" L.W. CONCRETE	6.00	.100	40.0	.200	5.000
C6	4" H.W. CONCRETE	4.00	1.000	140.0	.200	.333
C7	6" H.W. CONCRETE	6.00	1.000	140.0	.200	.500
B0	AIR SPACE RES	.00	.000	.0	.000	.910
F17	ACOUSTIC TILE	.75	.033	18.0	.320	1.894
F21	INSIDE AIR FILM	.00	.000	.0	.000	.610

LAMDA = .108　　WEIGHT = 153.39 LBM/SF　　U-VALUE = .057

DELTA = 12 HOURS　　HEAT CAPAC = 31.14 B/(SF-LB-F)　　C-COEF = .224E-03

J	B-COEFFICIENTS	D-COEFFICIENTS
0	.79886750E-13	.10000000E+01
1	.54834650E-07	-.25588320E+01
2	.62822170E-05	.24551110E+01
3	.55803190E-04	-.11209720E+01
4	.10231520E-03	.25496910E+00
5	.51808080E-04	-.27447290E-01
6	.78426260E-05	.11689990E-02
7	.34364940E-06	-.17920810E-04
8	.38852260E-08	.53410800E-07
9	.94458730E-11	-.23250100E-10

********** CUSTOMER DIRECT SERVICE NETWORK **********

For exclusive use by: REYNOLDS SMITH & HILLS

T R A N S F E R   F U N C T I O N   L I S T I N G

161 - HOSPITAL EXT, WALL U=0.068

LAYER CODE	DESCRIPTION	THICKNESS (INCHES)	CONDUCT (B/HR-FT-F)	DENSITY (LB/CF)	SP HEAT (B/LB-F)	RESISTANCE (SF-HR-F/B)
F1	OUTSIDE AIR FILM	.00	.000	.0	.000	.170
C1	4" L.W. CONCRETE	4.00	.100	40.0	.200	3.333
C1	4" L.W. CONCRETE	4.00	.100	40.0	.200	3.333
C8	8" H.W. CONCRETE	8.00	1.000	140.0	.200	.667
C8	8" H.W. CONCRETE	8.00	1.000	140.0	.200	.667
C7	6" H.W. CONCRETE	6.00	1.000	140.0	.200	.500
C10	4" L.W. CONCRETE BLK	4.00	.220	38.0	.200	1.515
B1	1" INSULATION	1.00	.025	2.0	.200	3.333
F16	1/2" GYPSUM BOARD	.50	.093	50.0	.200	.450
F5	INSIDE AIR FILM	.00	.000	.0	.000	.680

LAMDA = .108 WEIGHT = 298.25 LBM/SF U-VALUE = .068
DELTA = 12 HOURS HEAT CAPAC = 59.65 B/(SF-LB-F) C-COEF = .270E-03

J	B-COEFFICIENTS	D-COEFFICIENTS
0	.96047720E-13	.10000000E+01
1	.65927620E-07	-.25588320E+01
2	.75531010E-05	.24551110E+01
3	.67092090E-04	-.11209720E+01
4	.12301340E-03	.25496910E+00
5	.62288780E-04	-.27447290E-01
6	.94291770E-05	.11689990E-02
7	.41316910E-06	-.17920810E-04
8	.46712010E-08	.53410800E-07
9	.11356760E-10	-.23250100E-10

********** CUSTOMER DIRECT SERVICE NETWORK **********

For exclusive use by: REYNOLDS SMITH & HILLS

T R A N S F E R   F U N C T I O N   L I S T I N G

162 - MRI ROOF U=0.04

LAYER CODE	DESCRIPTION	THICKNESS (INCHES)	CONDUCT (B/HR-FT-F)	DENSITY (LB/CF)	SP HEAT (B/LB-F)	RESISTANCE (SF-HR-F/B)
F1	OUTSIDE AIR FILM	.00	.000	.0	.000	.170
F7	BUILT-UP ROOFING	.38	.094	70.0	.350	.333
F2	5/8" PLYWOOD	.63	.067	34.0	.290	.781
B6	6" INSULATION	6.00	.025	2.0	.200	20.000
B0	AIR SPACE RES	.00	.000	.0	.000	.910
F17	ACOUSTIC TILE	.75	.033	18.0	.320	1.894
F21	INSIDE AIR FILM	.00	.000	.0	.000	.610

LAMDA = .959 WEIGHT = 6.09 LBM/SF U-VALUE = .040
DELTA = 2 HOURS HEAT CAPAC = 1.84 B/(SF-LB-F) C-COEF = .236E-01

J	B-COEFFICIENTS	D-COEFFICIENTS
0	.49241600E-03	.10000000E+01
1	.10823720E-01	-.47190060E+00
2	.11106750E-01	.57090070E-01
3	.11997690E-02	-.15009020E-02
4	.10022410E-04	.34739480E-06
5	.22795300E-08	-.40425550E-11

********** CUSTOMER DIRECT SERVICE NETWORK **********

For exclusive use by: REYNOLDS SMITH & HILLS

T R A N S F E R   F U N C T I O N   L I S T I N G

163 - MRI EXT. WALL U=0.056

LAYER CODE	DESCRIPTION	THICKNESS (INCHES)	CONDUCT (B/HR-FT-F)	DENSITY (LB/CF)	SP HEAT (B/LB-F)	RESISTANCE (SF-HR-F/B)
F1	OUTSIDE AIR FILM	.00	.000	.0	.000	.170
A1	1" STUCCO	1.00	.400	116.0	.200	.208
F14	RIGID BOARD INSULATI	1.44	.026	.6	.200	4.528
F2	5/8" PLYWOOD	.63	.067	34.0	.290	.781
F3	3-1/2" INSULATON	3.50	.026	.6	.200	11.006
F16	1/2" GYPSUM BOARD	.50	.093	50.0	.200	.450
F5	INSIDE AIR FILM	.00	.000	.0	.000	.680

LAMDA = .875   WEIGHT = 13.77 LBM/SF   U-VALUE = .056
DELTA = 3 HOURS   HEAT CAPAC = 2.91 B/(SF-LB-F)   C-COEF = .193E-01

J	B-COEFFICIENTS	D-COEFFICIENTS
0	.13122000E-02	.10000000E+01
1	.11308720E-01	-.74834390E+00
2	.63333370E-02	.94484460E-01
3	.30117260E-03	-.29215280E-02
4	.18582420E-06	.16518660E-11

BD-312

RS&H

SUBJECT ______ AEP NO ______

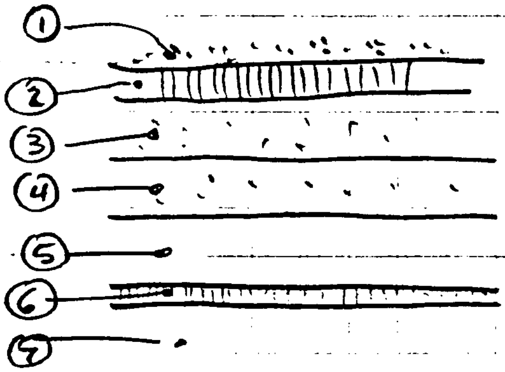
SHEET ______ OF ______

DESIGNER Hutchins DATE 12/5/95

CHECKER ______ DATE ______

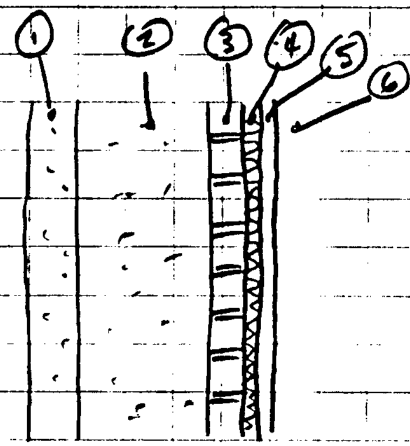
HOSPITAL Roof

TRACE CONSTRUCTION CODE = 160



		R	TRACE CODE
	Outside Air Resist.	0.17	F1
1	B/U roofing	0.33	F7
2	2" rigid insul.	4.52	F14
3	10" insul. conc.	8.33	C1, C2
4	10" concrete (roof slab)	0.83	C6, C7
5	12" airspace	0.91	B0
6	acoustical tile	1.90	F17
7	inside air film	0.61	F21
	$U = 1/\Sigma R = 0.058$ $\Sigma R =$	17.6	

HOSPITAL Exterior Wall TCC = 161



		R	TRACE CODE
	Outside Air Resist.	0.17	F1
1	8" arch. concrete	6.66	C1, C1
2	22" concrete	1.83	C8, C8, C7
3	4" cmu	1.52	C10
4	1" batt insul	3.33	B1
5	gyp. bd.	0.45	F16
6	inside air film	0.68	F5
	$U = 1/\Sigma R = 0.068$ ΣR	14.64	

RS&H

SUBJECT ____

DESIGNER ____

CHECKER ____

AEP NO ____

SHEET ____ OF ____

DATE ____

DATE ____

Floor Area Calc.

Floor	sf	Function
1 ST	88,561	Clinics
2 ND	120,461	Clinics
3 RD	120,132	Cafe, Surgical, Supply
4 Th	22,049	Admin
5	23,122	Intensive Care
6	27,038	Admin?
7		Admin?
8		Patient Beds
9		
10		
11		
12		
13		
SUB TOTAL	590,629	
Penthouse	11,304	
TOTAL	601,933	

RS&H

SUBJECT ______ AEP NO ______
SHEET ______ OF ______
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Supply AHUs

	Loc	cfm	Areas Served	min. OSA	(%)	TYPE	LAT	EXH	tons
✓ 1	2 (NW)	69,000	1st FL			CV	58.0	47,600	
✓ 2	2 (NW)	74,000	2nd FL	83,700 (127,000 max)	41	CV	58.0	18,100	813
✓ 3	2 (NW)	61,000	3rd FL			CV	58.0	31,300	
✓ 4a	14	81,000	4th-14th W	20,600	25		58.0	16,700	297
✓ 4b	14	85,000	4-14 E	19,300	23	CV	58.0	22,000	297
✓ 5	5	14,400	ICU	14,400	100	VV	50.4	14,400	108
✓ 6	3 ϕ	27,900	Surgical	27,900	100	VV	50.4	27,900	210
	TOTAL	412,300		165,900					1725

Return Fans (supply OSA for AHUs 1, 2 & 3)

	Loc			
✓ 1a	3	61,000	> 1-3	VV
✓ 1b	3	61,000		VV
✓ 2a	14	65,000	> 4-14	VV
2b	14	65,000		VV
	TOTAL	252,000		

Make-up AHUs

✓ 1	3	34,400	Kit hoods	VV

Economizer controls on CAHU: AHUs 1-4

RS&H

SUBJECT ________ AEP NO ________

SHEET ____ OF ____

DESIGNER ________ DATE ________

CHECKER ________ DATE ________

Exhaust Fans

		LOCATION	CFM	Type	SP	Serves
	1	14th Fl.	16,600	VV	3/4"	Toilets
	2	14th Fl.	22,000	VV	3/4"	"
	3	14th Fl.	3,700	VV	1 3/4"	Morgue 3rd
	4	14th Fl	16,900	VV	1 1/4"	Path Lab 1st
	5	5th FL (5A)	14,400	VV	3/4"	ICU
	6	3rd FL (3-L)	21,900	VV	3/4"	Surg. 3rd
✓	7	3rd FL Mech Rm.	35,600	CV	2 3/4"	Kit hoods
	8	2ND FL Equip.	6500	CV	1/2"	Eq. Rm (1)
	9	1st FL Equip	26,000	CV	1/2"	" "
	10	3rd FL MicroBio Lab	1490	CV	2"	Microbio. Lab
	11	14th FL Motor Exh	11,950	CV	–	Motor Exh
	12	3rd FL Col 14-C (3-D)	17,300	VV	3/4"	Toilet & Gen.
✓	13	3rd FL Col 1-M (3-M)	15,265	VV	3/4"	Locker Rm & 2ND FL TOILET
✓	14	3rd FL Col 6-M (3-M)	14,700	VV	3/4"	Supply
✓	15	3rd FL Col. 13-M (3-O)	12,000	VV	3/4"	Sterilizer Rm
✓	16	3rd FL Col 3-M (3-M)	16,610	VV	3/4"	Kitchen Exh.
	17	2ND FL Col 10-P (2-Q)	325	CV	2 1/2"	Allergy Clinic
		TOTAL	259,240			

(1) Interlocked with SF-7

RS&H

SUBJECT ____________________ AEP NO ____________

SHEET ______ OF ______

DESIGNER ____________________ DATE ____________

CHECKER ____________________ DATE ____________

Pumps

		GPM	HD
1	CW	2100	65'
✓✓✓ 2	HW	965	75'

Heat Exchanger Steam-to-Hot Water - Has HWT Reset

		GPM	PD
1	—	1050	2.5"
2	—	500	1.3"

Reheat Coils PD = 0.34" H_2O

		MBH	GPM	CFM
✓✓	Surgery Zones 1-12	848	84.8	19,425
✓✓	5th FL Zones 1-13	352	35.2	8150
✓✓✓	2ND FL (EQUIP RM)	272	27.2	6300
	TOTALS	1472	147.2	33,875

There are additional
convectors
cabinet heaters
unit heaters
fin tube radiation (4th FL)

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SUBJECT ______________________

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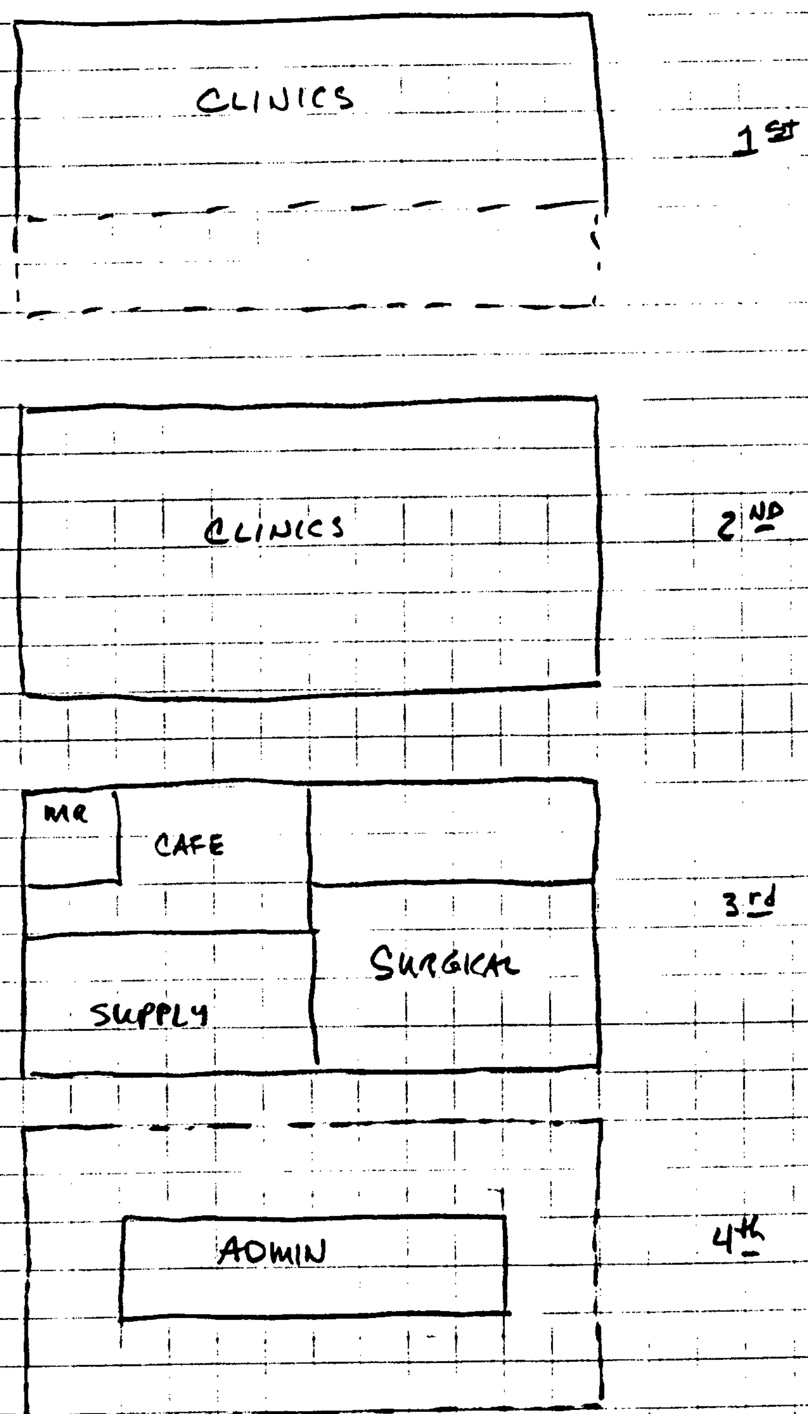
DATE ______________________



BD-37

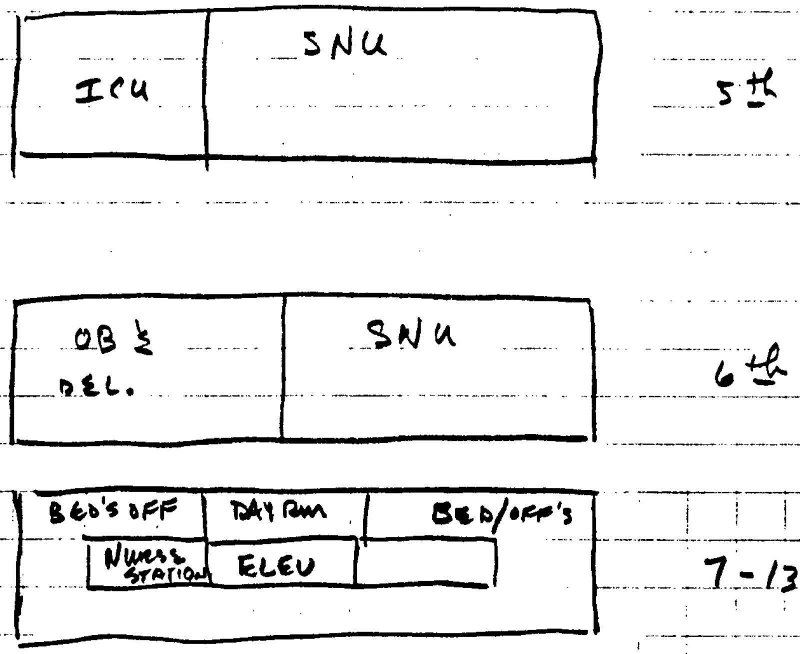
RS&H

SUBJECT ______________________ AEP NO ______________

______________________ SHEET ________ OF ________

DESIGNER ______________________ DATE ______________

CHECKER ______________________ DATE ______________



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FAN KW

SF	TRACE #	AREA SERVED	SP	CFM CALC'D [1]	CFM ADJ'D [2]	KW	MOTOR BHP	EFF
1	1	1ST FLR	6.4	94,772	79,000	80	100	93.5
2	2	2ND FLR	5.7	103,300	91,000	80	100	93.5
3	3	3RD FLR	6.6	93,952	79,000	80	100	93.5
4A	4	EAST TWR	5.5	106,939	107,000	100	125	93.6
5	5	ICU +	5.6	27,064	17,000	17	20	88.5
6	6	SURGICAL	5.5	38,177	32,000	33	40	91.0
4B	7	WEST TWR	5.75	102,038	102,000	100	125	93.6
-	8	MRI	-	-		-	-	-
-	9	FAM. PRACT.	-	-		-	-	-
KM	10	KIT. M-U	2.8	39,221	39,200	16	20	92.0
-	11	MED. BKS	-	-		-	-	-
4A	4	Rtn				13	15	87.5
4B	7	"				13	15	87.5
1,2,3	1	"				25	30	89.5
1,2,3	2	"				25	30	89.5
-	10	KIT EXH				60	100	93.5
						642		

(1) Based on fan curves, RPM and SP
(2) Adjusted for motor max BHP except for Kit fans (@ 75%)

RS&H

SUBJECT ______________________ AEP NO ______________________

SHEET ________ OF ________

DESIGNER B. Todd DATE ______________________

CHECKER ______________________ DATE ______________________

Air Flow Measurements

FAN No.	DESIGN CONDITIONS SP " H_2O	FAN RPM	SUPPLY CFM	OA%	EXISTING CONDITIONS SP " H_2O	FAN RPM	SUPPY CFM	OA%
SF-1	6.56	921	69,000	36%	6.40	1067	79,000	19%
SF-2	6.50	798	74,000	36%	5.70	880	91,000	19%
SF-3	6.50	886	61,000	36%	6.60	1069	79,000	19%
SF-4A	7.00	847	83,000	25%	5.50	890	107,000	29%
SF-4B	7.00	847	83,000	25%	5.75	876	102,000	37%
SF-5	6.75	921	14,400	100%	5.60	1731	17,000	100%
SF-6	6.75	1363	27,900	100%	5.50	1467	32,000	100%
KMUA	2.50	684	32,000	100%	2.80	795	39,200	100%

FAN PERFORMANCE INTERPOLATION
Filename: FPI-490.WQ1

Fan Mfg: Peerless
Model #: P-490
Type : SWSI

	SP =>	2.50 in	2.80 in	3.00 in
	30371 cfm	660 rpm	677 rpm	688 rpm
	33132 cfm	700 rpm	713 rpm	721 rpm
@ RPM =	684	32028 cfm	30926 cfm	N/A cfm
	38654 cfm	773 rpm	787 rpm	797 rpm
	41415 cfm	810 rpm	824 rpm	834 rpm
@ RPM =	795	40296 cfm	39221 cfm	N/A cfm

FAN PERFORMANCE INTERPOLATION
Filename: FPI-330.WQ1

Fan Mfg: Peerless
Model #: P-330
Type : DWDI

	SP =>	5.50 in	in	in
	35064 cfm	1423 rpm	0 rpm	rpm
	38318 cfm	1469 rpm	0 rpm	rpm
@ RPM =	1467	38177 cfm	N/A cfm	N/A cfm
	cfm	rpm	0 rpm	rpm
	cfm	rpm	0 rpm	rpm
@ RPM =		N/A cfm	N/A cfm	N/A cfm

AHU fans: Margie, Kent 396-3424

① Peerless:

P 542 ✓ DWDI, class III
P 490 ✓
P 330 ✓ DWDI, class III
60 (axial) Belt drive

② AAF

Type W roto-clone
Size 36

	CFM	RPM		CFM	RPM
SF #1	64608	901	→	69000	921 ✓
	69577	924			
SF #3	59638	881	→	61000	886 ✓
	64608	901			
MUA	29619	526	→	32000	530 ✗
SWSI	32304	531			

① $OACFM \times 64.8 + RACFM \times 75.6 = 106939 \times 72.5$

② $OACFM + RACFM = 106939$

$OACFM = 106939 - RACFM$

$(106939 - RACFM) * 64.8 + RACFM \times 75.6 = 7753077.5$

$6929647.2 - 64.8\ RACFM + 75.6\ RACFM = 7753077.5$

$(75.6 - 64.8)\ RACFM = 823430.3$

$RACFM = 823430.3 / (75.6 - 64.8)$

$RACFM = 76{,}243.5$

$OACFM = 106939 - 76243.5$

$OACFM = 30695.4$

~~cfm × 74.5 + cfm × 81.0 = 78.0~~

1 $X \times 65.5 + Y \times 81.0 = 292024 \times 78.0$

2 $X + Y = 292024$

$X = 292024 - Y$

$$(292024 - Y)\,65.5 + Y \times 81 = \overset{MACFM \times MAT}{292024 \times 78}$$

$19127572 - 65.5Y + 81Y = 22777872$

$81Y - 65.5Y = 22777872 - 19127572$

$15.5\,Y = 3650300$

RA cfm $Y = 235503$ cfm

$X = 292024 - Y$

$X = 292024 - 235503$

OA cfm $X = 56521$ cfm ~ 19%

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2} \qquad Q_1 = Q_2 \times \frac{N_1}{N_2}$$

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^2 \qquad P_1 = P_2 \times \left(\frac{N_1}{N_2}\right)^2$$

SF-1 ⇒ $Q = 69000 \times \left(\frac{1067}{921}\right) = 79{,}938$ cfm
P-490 SP = 6.4 CFM ⇒ 94,772 CFM
RPM = 1067

SF-2 ⇒ $Q = 74{,}000 \times \left(\frac{880}{798}\right) = 81{,}604$ cfm
P-542 SP = 5.7 CFM ⇒ 103,300 CFM
RPM = 880

SF-3 ⇒ $Q = 61{,}000 \times \left(\frac{1069}{886}\right) = 73{,}599$ cfm
P-490 SP = 6.6 93,952 cfm
RPM = 1069 CFM ⇒

SF-4E ⇒ $Q = 83000 \times \left(\frac{890}{847}\right) = 87{,}214$ cfm
P-542 SP = 5.5 RPM = 890 106,939 cfm

SF-4W ⇒ $Q = 83000 \times \left(\frac{876}{847}\right) = 85{,}842$ cfm
P-542 SP = 5.75 RPM = 876 102,038 cfm

SF-5 ⇒

SF-6 ⇒ $Q = 27000 \times \frac{1467}{1363} = 29{,}060$ cfm
P-330 SP = 5.5 RPM = 1467

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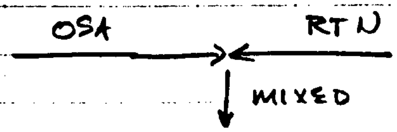
OSA Calculations



$$OSA_T * OSA_{CFM} + RTN_T * RTN_{CFM} = MIXED_T * MIXED_{CFM} \quad (1)$$

$$OSA_{CFM} + RTN_{CFM} = MIXED_{CFM} \quad (2)$$

$$RTN_{CFM} = MIXED_{CFM} - OSA_{CFM} \quad (3)$$

Measured OSA_T, RTN_T, $MIXED_T$, $MIXED_{CFM}$

Combining Eqns. (1) & (2)

$$OSA_T * OSA_{CFM} + [MIXED_{CFM} - OSA_{CFM}] * RTN_T = MIXED_T * MIXED_{CFM}$$

$$O_T O_C + R_T M_C - R_T O_C = M_T M_C$$

$$O_T O_C - R_T O_C = M_T M_C - R_T M_C$$

$$O_C (O_T - R_T) = M_C (M_T - R_T)$$

$$O_C = \frac{M_C (M_T - R_T)}{O_T - R_T}$$

RS&H

SUBJECT

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OSA Calculations

AHU #1	M_c	M_T	O_T	R_T	O_c	% OSA
1, 2, 3	103,300	78.0	65.5	81.0	20,000	19.4
4A	106,900	72.5	64.8	75.6	30,700	28.7
4B	102,000	74.5	71.9	76.0	37,300	36.6

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Airflow Calc's

$$\frac{1\,AC}{HR} = \frac{H * SF}{HR}$$

$$= \frac{H * SF}{\cancel{HR}} \cdot \frac{HR}{60\,M} = \frac{H * SF}{60}\,(cfm)$$

$$= \frac{\frac{H * \cancel{SF}}{60}}{\cancel{SF}} = \frac{H}{60}\left(\frac{cfm}{sf}\right)$$

For 9' ceilings

$$\frac{1\,AC}{HR} = \frac{9}{60}\,\frac{cfm}{sf}$$

$$= 0.15\,\frac{cfm}{sf}$$

Minimum OSA req's for most areas is 2AC/HR

This is equivalent to $0.3\,\frac{cfm}{sf}$

RS&H

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AIR FLOW CALC'S

	SUPPLY AIR (cfm)			
SF	DESIGN	MEASURED	REQ'D[1]	(AC/HR)
1	69,000	79,000	64,974	4.9[2]
2	74,000	91,000	72,000	4
3	61,000	79,000	58,200	4
4A	83,000	107,000	77,115	4
4B	83,000	102,000	77,955	4
5	14,400	17,000	12,960	6
6	27,900	32,000	24,750	8.25[3]

	OUTSIDE AIR (cfm)			
SF	DESIGN	MEASURED	REQ'D[1]	(AC/HR)[4]
1	24,840	15,010	16,600	1.25
2	26,640	17,290	18,000	1
3	21,960	15,010	14,600	1
4A	20,750	31,030	24,100	1.25
4B	20,750	37,740	24,100	1.25
5	14,400	17,000	4419	1.75
6	32,000	32,000	8250	2.75[5]

(1) Minimum

(2) 4AC/HR FOR MOST SPACE, 6AC/HR FOR LABS & Phys. Med (45%)

(3) 6AC/HR for support areas, 15AC/HR for OR (25%) & 3AC/HR when not used

(4) Corridors (25% of area)

(5) 2 AC/HR for support areas, 5 AC/HR for OR (25%), 3 AC/HR when not in use

Eisen hower Army Medical Center
Fort Gordon, GA
Lighting Inventory
Filename: LIGHTS.WK3

Table 2.1-1 Lighting Systems Inventory

				Fluorescents											Incandescents				M-V		
Floor	Space	Description	Area (sf)	2L f40U	2L f40wm	2L f40	3L f40wm	4L f40wm	4L f40	2L f32	6L f40	8L f40	2L f96	circln	1L(N) a60	1L(R) a100	1L p150	1L a200	(L) 175w	kW	(w/sf)
1	1a	Clinics	6,048			31										14				3.5	0.58
1	1b	"	8,064			164			1											14.9	1.85
1	1c	Admin/Comp.	10,080			111			28					66		47				22.2	2.20
1	1d	Surg. Clinic	10,080			81			83		8					11				25.0	2.48
1	1e	Admin/Comp.	5,040			76										2				6.9	1.38
1	1f	Admin.	4,200			64										4				6.0	1.42
1	1g	"	2,856			30			6							4				4.0	1.40
1	1h	Labs	5,040			40						23								11.9	2.36
1	1i	Phys. Med.	10,080			103			37							6				16.2	1.61
1	1j	"	8,064			111			5							20				11.9	1.48
1	1k	Labs	6,116			89			31							4				13.8	2.26
1	1l	"	9,912			52						93								38.2	3.85
2	2a	Mech. Rm.	6,720			23										8				2.5	0.37
2	2b	Clinics	7,392			62			53											15.1	2.05
2	2c	Lobby/Admin	10,080			66													113	28.5	2.83
2	2d	Emergency	10,080			93			68							4				20.8	2.07
2	2e	Clinics	6,048			50			38							5				11.6	1.92
2	2f	"	7,256			70			54							5				16.3	2.24
2	2g	"	5,292			64										9				6.2	1.18
2	2h	Adm/Records	8,064			138			13							2				14.9	1.84
2	2i	Clinics	7,812			78										2				7.1	0.91
2	2j	"	3,024			27			14											5.0	1.64
2	2k	"	4,645			56										10				5.6	1.20
2	2l	"	4,990			31			19							5				6.5	1.30
2	2m	Admin.	3,744			63										1				5.7	1.53
2	2n	Clinic	3,216			40										1				3.7	1.14
2	2o	"	10,080	2		61			70											18.2	1.81
2	2p	"	8,064	16		44			70							20		9		19.2	2.38
2	2q	"	8,064			100			11								4			11.2	1.39
2	2r	"	8,064			139			23						3		6			17.1	2.12
2	-	MRI	2,940						30											5.4	1.84
2	-	Fam. Pract.	26,000	45	134		11	152												36.0	1.39
3	3a	Mech. Rm.	4,032			17										8		1		2.0	0.50
3	3b	Cafeteria	10,512			17							84			10				15.3	1.46
3	3c	Dining Rm	9,744			52										4			54	15.7	1.61
3	3d	Admin	10,206			110			44							37	2	6		20.2	1.98
3	3e	Linen	7,776			92											3			8.4	1.08
3	3f	Admin	10,344			116			9											12.1	1.17
3	3g	Pharm. Stg.	4,656			57			15											7.8	1.68
3	3h	Surgical	4,536			55										27				6.4	1.40
3	3i	Admin	4,032			49			12							6				6.9	1.71
3	3j	"	5,040			32			36								4			9.6	1.90
3	3k	Pharm. Stg.	10,080	3		107			8		2					16				12.7	1.26
3	3l	Surgical	4,536	21		49			6							3		1		7.2	1.59
3	3m	Supply	10,080						8										76	16.6	1.65
3	3n	"	10,080						17										72	17.5	1.73
3	3o	"	6,048			20													26	7.0	1.16
3	3p	Surgical	8,064			120			11							5	8			13.5	1.67
4	floor	^	22,200			98			87			3	10			19		24	151	59.6	2.68
5	floor		23,100			95			26						52	23				17.1	0.74
6	floor		27,000	4		267			16						57	41				32.3	1.20
7	floor	Admin	27,000	4		267			16						57	41				32.3	1.20
8	floor	+	27,000	2		267			16						57	41				32.2	1.19
9	floor	Patient	27,000	2		267			16						57	41				32.2	1.19
10	floor	Areas	27,000	2		102			16	148					54	41				25.7	0.95
11	floor		27,000	2		267			16						57	41				32.2	1.19
12	floor		27,000	2		260			11						54	41				30.5	1.13
13	floor	v	27,000	5		243									78	39				28.3	1.05
14	floor	Mech. Rm.	11,250			48														4.3	0.38
Totals			629,471	110	134	5231	11	152	1040	148	10	119	94	66	526	668	27	41	492	936.5	1.49
1st Floor			86,580	0	0	952	0	0	191	0	8	116	0	66	0	112	0	0	0	174.6	2.04
2nd Floor			122,635	18	0	1,205	0	0	433	0	0	0	0	0	3	72	10	9	113	215.2	1.75
MRI			2,940	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	5.4	1.84
Fam. Pract.			26,000	45	134	0	11	152	0	0	0	0	0	0	0	0	0	0	0	36.0	1.39
3rd Floor			119,766	24	0	893	0	0	166	0	2	0	84	0	0	116	17	8	228	178.7	1.49
Fix. watts				72	72	90	115	144	180	58	270	360	158	72	52	52	52	52	200		
kw totals			936.5	7.9	9.6	470.8	1.3	21.9	187.2	8.6	2.7	42.8	14.9	4.8	27.4	34.7	1.4	2.1	98.4		

Fixture wattage for standard 40watt fluorescents are averaged using values for standard and energy efficient electromagnetic ballasts

2L-F40 - Fixture types A,B,C,D,E,E1,F,F1,J1,K,H2
4L-F40 - Fixture types C1,D1,E2,E3
6L-F40 - D2
8L-F40 - D3
2L-F96 - F2,H3,J,AF

R - fixture over toilet
N - fixture over sink

MIL-HDBK-1191
15 OCTOBER 1991

MILITARY HANDBOOK

DEPARTMENT OF DEFENSE

MEDICAL AND DENTAL TREATMENT FACILITIES

DESIGN AND CONSTRUCTION CRITERIA

AMSC N/A

AREA FACR

DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

BD-51

APPENDIX A
ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

ROOM CODE	ROOM NAME	ARCHITECTURAL FINISHES FLOOR	BASE	WALL	CEILING	C'LG HT	DOORS SIZES	ACOUSTICAL NOISE LEVEL IN RM	STC	FLR LD PSF kPa	ELECTRICAL ILL fc	EMERG POWER
OPST1	OUTPAT STRESS TESTING	VCT	R	GWP	ACT1	9'-0" 2750mm	3'-6" 1050mm	35-40	50	60 2.9	50	***
OPSW1	OPTICAL SVC WORK AREA	VCT	R	GWP	ACT1	8'-0" 2400mm	3'-0" 900mm	30-35	40	60 2.9	100	***
OPTM1	OUTPAT TREADMILL ROOM	VCT	R	GWP	ACT1	9'-0" 2750mm	3'-6" 1050mm	35-40	50	60 2.9	50	***
OPVC1	OUTPAT VECTORCARDIO	VCT	R	GWP	ACT1	8'-0" 2400mm	3'-0" 900mm	30-35	40	60 2.9	50	***
OPVL1	OUTPAT VASCULAR LAB	SV	R	GWL	ACT1	8'-0" 2400mm	3'-0" 900mm	30-35	40	60 2.9	50G 100	***
ORCH1	OR CARDIAC MONITORING	SV	IV	GWL	ACT1	10'-0" 3000mm	4'-0" 1200mm	30-35	40	60 2.9	200 M;E	LB;RA
ORCS1	OR CYSTOSCOPIC SURGERY	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	30-35	45	60 2.9	200 M;E	LB;RA
ORCT1	OR CARDIOTHORACIC SURG	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	30-35	45	60 2.9	200 M;E	LB;RA
ORCW1	OR CLEAN WORK	ET/ SV	CT/ IV	CT/ GWL	GWL	9'-0" 2750mm	3'-0" 900mm	30-35	45	60 2.9	100 M	L;R
ORDA1	OR DECONTAMINATION	CT/ SV	CT/ IV	CT/ GWL	GWL	9'-0" 2750mm	3'-0" 900mm	30-35	45	60 2.9	30	L;R
OREC1	OR EQUIPMENT CLEANUP	VCT/ SV	R/ IV	CT/ GWL	GWL	9'-0" 2750mm	3'-6" 1050mm	30-35	45	60 2.9	30	L;R
ORGS1	OR GENERAL SURGERY	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	30-35	45	60 2.9	200 M;E	LB;RA
ORHL1	OR HEART LUNG PUMP	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	***	***	60 2.9	20	LS
ORNE1	OR NEUROSURG EQ STOR	SV	IV	GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	***	***	125 6.0	20	LS

APPENDIX A
ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

L GASES xygen MV-Med Vac MA-Med Air NO-Nitrous Oxide itrogen GA-Gas DA-Dental Air OE-Oral Evac ab Air PA-Process Air LV-Lab Vac.	NOTES	INTERIOR MECHANICAL DESIGN CONDITIONS 1 AIR BAL	2 AIR CHG	3 MIN OA	4 TEMP SUM	 WIN	5 REL HUM	6 FILTRATION PRE	 FIN	7 EXH	NOTES
1MV 1MA	3	0	4	2	78F 26C	70F 21C	***	25%	***	***	
--		0	4	1	78F 26C	68F 20C	***	25%	***	***	
1MV 1MA	3	0	4	2	78F 26C	70F 21C	***	25%	***	***	
1MV 1MA	3	0	4	2	78F 26C	68F 20C	***	25%	***	***	
1MV 1MA	3	-	4	2	78F 26C	70F 21C	***	25%	***	***	
4MV 2MA	3	0	6	2	78F 24C	70F 20C	***	25%	90%	***	
MV 1MA 1NO	5	++	15	5	68-76F 20-24C		50-60	25%	90%		8 21
MV 4MA 2NO 2NI	5,7	++	15	5	68-76F 20-24C		50-60	25%	99.97%		8 21
		+	6	2	75F 24C	—	***	25%	90%	***	
1MV 1MA 1NI	10	—	10	2.5	75F 24C	--	***	25%	90%	YES	17
MV 1MA 1NI	10	+	6	2	75F 24C	--	***	25%	***	YES	
MV 4MA 2NO 2NI	5,7	++	15	5	68-76F 20-24C		50-60	25%	90%		8 21
		++	15	5	68-76F 20-24C		50-60	25%	99.97%		8 21
		+	6	1.5	75F 24C	—	***	25%	90%	***	

APPENDIX A
ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

INTERIOR MECHANICAL DESIGN CONDITIONS
FOR SPECIFIC AREAS, MEDICAL AND DENTAL TREATMENT FACILITIES (continued):

Relative Humidity (RH). This is the relative humidity to be maintained in a space as part of the designed conditions. The humidity may vary from 30 percent to 60 percent except where other design values are given or where there is no requirement for humidity control. Specific summer RH control is not required except for those areas provided under specific notes. Winter RH control is not required except as provided under notes.

Filtration. Up to three filter types may be required. The Orthopedic Operating Room requires a 25 percent prefilter, a 90 percent intermediate filter, and a 99.97 percent final filter. The values for the first two filters (see Appendix A) are by the atmospheric dust spot efficiency test. The atmospheric dust spot efficiencies are the minimum average and are based on ASHRAE Standard 52-76. The third filter where required is a HEPA filter which uses the DOP (Dy-Octyl Phthalate, or bis(2-ethylhexyl phthalate) test method. The DOP test efficiency is based on MIL-STD 282. All filters should be installed to prevent leakage between the filter segments and between the filter and its supporting frame.

7. Exhaust Outside. This column lists areas that require 100% exhaust directly to the outside.

8. Air supply shall be 15 air changes per hour unless a higher rate is required to meet cooling requirement and may be totally exhausted when the room is in use. The option as whether to utilize recirculated air during an operation is left to the discretion of the individual Military Departments. Should recirculated air be utilized the minimum outside air requirements would apply. During period of non-use, either (1) 75% of the air may be recirculated or (2) the air volume may be reduced to 3 air changes per hour, while maintaining the required air balance. All systems shall, if cost effective, use exhaust air energy recovery to precondition the incoming outside air.

9. Room exhaust directly over patient stations.

10. For negative isolation, room shall be negative to anteroom and positive to toilet. For positive isolation, room shall be positive to both anteroom and toilet. Anteroom shall be negative to corridor at all times. For isolation room used for patients with a high susceptability to infection from leukemia, burns, bone marrow transplant, organ transplant, or Acquired Immunodeficiency Syndrome, HEPA should be used on air supply system.

11. Exhaust all to outside applicable to process only.

RS&H®

Telephone Call Confirmation

Project Number (904) 642-8701

Local ✓ L.D. ____ Placed ✓ Rec'd ____ Date 9/12/95

Conversed with Bob Baker Of ____

Regarding York Chillers at Ft. Gordon

PH requested performance data on York Chillers

~1050 tons each

Model YT L6 M6 F2-CB C R-11

Evap & Cond are both 2-pass

Distribution:

BD-55

RS&H

SUBJECT
DESIGNER Hutchin
CHECKER
AEP NO
SHEET OF
DATE 11/28/95
DATE

Absorption Chiller Tests

4:10 pm 11/16/95
OSA = 58F/47F

	Pressure (psig)	Temp. (°F)
Chilled Water Supply	50	52
Chilled Water Return	76	60
Condenser Water Supply	11	105
Condenser Water Return	25	84

Pressure Drops

Chilled Water	59.8 ft
Condenser Water	32.2 ft

Based on the fact that pressure drop due to flow of fluids in turbulent range through valves and fitting varies as the square of the velocity.

Chilled Water Design 1152 gpm @ 20.1 ft PD
Condenser Water Design 2117 gpm @ 29.5 ft PD

$$\frac{CHW^2}{(1152\,gpm)^2} = \frac{59.8}{20.1} \qquad CHW = 1987\ gpm$$

$$\frac{CNW^2}{2117^2} = \frac{32.2}{29.5} \qquad CNW = 2212\ gpm$$

RS&H

SUBJECT
DESIGNER
CHECKER

AEP NO
SHEET ___ OF ___
DATE 11/28/95
DATE

$$TONS = \frac{500 * gpm * \Delta T}{12{,}000}$$

$$\frac{500 * 1987 * (60-52)}{12000} = \underline{662 \text{ tons}}$$

This is 30% above rated capacity.

Calculated COP

$$= \frac{\text{Output (Btu/hr)}}{\text{Input (Btu/hr}}$$

$$= \frac{662 * 12000}{3445 \frac{cf}{hr} * 1041 \frac{Btu}{cf}} = \underline{2.2}$$

COP should be about 0.6 - This value is too high to be believed.

$$\text{Full load nat. gas rate is} = \frac{\text{Capacity (Btu/hr)}}{COP} \div 1041 \frac{Btu}{cf}$$

$$= \frac{500 * 12000}{(0.6)(1041)} = 9606 \frac{cf}{hr}$$

GAS RATE READINGS ARE SUSPECT

D. ECO BACKUP DATA - ANALYSIS, COST ESTIMATES, AND LIFE CYCLE COST ANALYSIS

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******************************************************************************
******************************************************************************
**                                                                          **
**              T R A C E   6 0 0   A N A L Y S I S                         **
**                                                                          **
**              by  C.D.S. MARKETING                                        **
**                                                                          **
******************************************************************************
******************************************************************************
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EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
DOUBLE PANE WINDOWS   ECO # BE2

Weather File Code:	AUGUSTA	
Location:		
Latitude:	33.0	(deg)
Longitude:	82.0	(deg)
Time Zone:	5	
Elevation:	143	(ft)
Barometric Pressure:	29.8	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	95	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	23	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

ENERGY SAVINGS

ELC (kwh)	NGAS (therms)
22,118,931	622,460
22,118,272	621,844
659	616
2 M BTU	62 M BTU

Design Simulation Period: July   To July
System Simulation Period: January   To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 18:18:44   6/27/96
Dataset Name: DPWIND .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,549,433	2,727	78,250	2,060	188
Feb	1,375,042	2,724	73,344	1,842	188
March	1,685,429	2,818	60,125	2,166	184
April	1,801,193	2,967	45,512	2,401	164
May	1,973,581	3,391	41,149	2,847	157
June	2,172,446	3,643	35,707	3,573	152
July	2,287,319	3,639	37,840	3,816	154
Aug	2,267,440	3,688	37,812	3,801	155
Sept	2,026,936	3,523	39,066	3,071	157
Oct	1,738,662	2,895	52,358	2,153	169
Nov	1,628,394	2,868	55,043	2,014	180
Dec	1,612,395	2,755	65,638	2,011	187
Total	22,118,272	3,688	621,844	31,756	188

Building Energy Consumption = 187,940 (Btu/Sq Ft/Year)   Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 398,543 (Btu/Sq Ft/Year)

BE 2-2

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

------------------------------------- U T I L I T Y   P E A K   C H E C K S U M S -------------------------------------

Utility ELECTRIC DEMAND

Peak Value 3,688.1 (kW)
Yearly Time of Peak 18 (hr) 8 (mo)

Hour 18 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	766.6	20.79
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	609.5	16.53
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.8	0.73
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	63.5	1.72
Sub Total			1,466.4	39.76
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.52
Sub Total			56.0	1.52
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.77
2		SUMMATION OF FAN ELECTRICAL DEMAND	102.1	2.77
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.25
4		SUMMATION OF FAN ELECTRICAL DEMAND	115.9	3.14
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.58
6		SUMMATION OF FAN ELECTRICAL DEMAND	34.7	0.94
7		SUMMATION OF FAN ELECTRICAL DEMAND	117.4	3.18
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.4	0.23
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	2.06
Sub Total			662.5	17.96
Sub Total			0.0	0.00
Miscellaneous				
Lights			732.6	19.86
Base Utilities			0.0	0.00
Misc Equipment			770.6	20.89
Sub Total			1,503.1	40.76
Grand Total			3,688.1	100.00

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

---------- CALIFORNIA TITLE 24 COMPLIANCE REPORT ----------

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

---------- E N E R G Y   U S E   S U M M A R Y ----------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	35,245,560.0	385.8	26.0	38,554,220.0	53.9
Primary Cooling						
Compressor	2,715,432.0	0.0	0.0	6.7	27,806,088.0	38.9
Tower/Cond Fans	543,950.0	0.0	31,074.9	1.3	5,570,061.0	7.8
Condenser Pump	1,026,209.7	0.0	0.0	2.5	10,508,412.0	14.7
Other Accessories	818,233.3	0.0	0.0	2.0	8,378,728.0	11.7
Auxiliary						
Supply Fans	5,549,681.0	0.0	0.0	13.8	56,828,864.0	79.5
Circulation Pumps	679,279.6	0.0	0.0	1.7	6,955,839.5	9.7
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	6,228,960.5	0.0	0.0	15.4	63,784,704.0	89.3
Lighting	5,344,352.5	0.0	0.0	13.2	54,726,296.0	74.7
Receptacle	5,299,176.5	0.0	0.0	13.1	54,263,692.0	74.1
Domestic Hot Water	0.0	26,938,824.0	294.9	19.6	28,356,658.0	38.7
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	22,118,270.0	62,184,384.0	31,755.6	100.0	291948832.0	403.8

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: DOUBLE PANE WINDOWS

Card 08---------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09------------------- Load Simulation Periods -------------------------

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10------------- Load Simulation Parameters ---------------------

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11--------- Energy Simulation Parameters -----------------

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	BASELINE

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
510	1	90				0			
512	1	90				180			
514	1	77				270			
520	1	70				0			
522	1	70				180			
530	1	140				0			
532	1	77				90			
534	1	140				180			
M610	1	100	11.5	0.068	161	0			
612	1	100				180			
614	1	90				270			
620	1	100				0			
622	1	100				180			
630	1	100				0			
632	1	90				90			
634	1	100				180			
710	1	130				0			
712	1	130				180			
714	1	90				270			
720	1	170				0			
722	1	90				90			
724	1	170				180			
900	1	185	22.6			0			
902	1	185	22.6			90			
904	1	185	22.6			180			
906	1	185	22.6			270			

Card 25--- Wall/Glass Parameters ---

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
M300	1			10	0.55	0.9					
310	1			75		0.8					
320	1			5							
M400	1			50	0.55	0.9		3			
410	1										
420	1										
430	1										
M510	1			20	0.55	0.9	3	3			
512	1										
514	1										
520	1										
522	1										
530	1										
532	1										

U-Value of double pane windows for all floors

Card 25 ---------- Wall/Glass Parameters ----------

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
534	1										
M610	1			10	$\boxed{0.55}$	0.9	3	3			
612	1										
614	1										
620	1										
622	1										
630	1										
632	1										
634	1										
710	1										
712	1										
714	1										
720	1										
722	1										
724	1										
M900	1			20	1.04	1.		3			
902	1										
904	1										
906	1										

U-value of double pane windows for all hospital floors

Card 26 ---------- Schedules ----------

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
M100	A-P8HPD	A-L8HPD	AVAIL	OFF		AVAIL	AVAIL	AVAIL	AVAIL	
160	AVAIL	AVAIL								
170	AVAIL	AVAIL								
180	AVAIL	AVAIL								
190	NONE	NONE	NONE	NONE		NONE	NONE			
M210	AVAIL	AVAIL	AVAIL	AVAIL		AVAIL	AVAIL	AVAIL	AVAIL	
240	NONE	NONE	NONE	NONE		NONE	NONE			
M300	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
302						A-MODSKF			A-MODSKF	
330	A-P8HPD	A-L8HPD								
332	A-P8HPD	A-L8HPD								
334	A-P8HPD	A-L8HPD								
350	NONE	NONE	NONE	NONE		NONE	NONE			
M510	AVAIL	AVAIL	AVAIL	OFF		AVAIL	AVAIL		AVAIL	
M610	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
800	NONE	NONE	NONE	NONE		NONE	NONE			
810	NONE	NONE	NONE	NONE		NONE	NONE			

CONSTRUCTION COST ESTIMATE

Project:	ECO BE2 Install Double -Glazed Windows	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/9/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	'EST_BE2.XLS

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
6'0"x4'10" alum wind w/	402	ea	$395.00	$158,790	$74.50	$29,949	$188,739	MBp234	MBp234
insulating glass									
4'3"x4'10" alum wind w/	64	ea	$238.00	$15,232	$39.50	$2,528	$17,760	MBp234	MBp234
insulating glass									
Remove existing windows	466	ea			$14.40	$6,710	$6,710	MBp38	MBp38
Subtotal Bare Costs				$174,022		$39,187	$213,209		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$174,022		$39,187	$213,209		
City Cost Index (Aug. GA)			-9%	($15,662)	-41%	($16,067)	($31,729)	MBp578	MBp578
				-		-	-		
Subtotal				$158,360		$23,120	$181,480		
OH & Profit Markups			10%	$15,836	53%	$12,254	$28,090	MMp7	MMp475
				-		-	-		
Subtotal				$174,196		$35,374	$209,570		
Sales Taxes			6.0%	$10,452		NA	$10,452	MMp476	
				-		-	-		
Subtotal				$184,648		$35,374	$220,022		
Contingency			10%	$18,465	10%	$3,537	$22,002	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$203,113		$38,911	$242,024		
Design Fee				NA	6.0%	$13,201	$13,201		
SIOH				NA	6.0%	$13,201	$13,201		
				-		-	-		
Total Project Cost				$203,113		$65,313	$268,426		

LEGEND:

MMp### 1996 Means Mechanical Cost Data, page ###.
MEp### 1996 Means Electrical Cost Data, page ###.
Gp### 1995 Grainger, page ###
Dp### 2/94 DGSC Energy Efficient Lighting, page ###
MBp### 1996 Means Building Construction Cost Data, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: BE2
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BE2 DOUBLE-GLAZED WINDOWS
FISCAL YEAR 96 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 242000.		
B. SIOH	$ 14520.		
C. DESIGN COST	$ 14520.		
D. TOTAL COST (1A+1B+1C)	$ 271040.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 271040.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	2.	$ 15.	13.68	$ 208.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	62.	$ 167.	17.25	$ 2888.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		64.	$ 183.		$ 3096.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 183.

5. SIMPLE PAYBACK PERIOD (1G/4) ****** YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 3096.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .01
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -16.36 %

RS&H

SUBJECT Ft Gordon Hospital
DESIGNER GWP
CHECKER
AEP NO
SHEET OF
DATE 2-14-96
DATE

ECO BP1B REDUCE BOILER PRESSURE FROM 60 psig to 30psig

Reducing the boiler pressure to 30 psig will require a new steam source to the autoclaves. This ECO evaluates the feasibility of using an electric boiler for this purpose.

The speadsheet analysis that follows shows how efficiency increases with decreases in boiler steam pressure (p BPIB-

Press (psig)	Eff.	
90	80.0 %	(Reference eff. from New boiler spec.)
60	80.6 %	
30	81.4 %	

AUTOCLAVE ANNUAL ENERGY CONSUMPTION

AUTOCLAVES CONSUME UP TO 743 LBS/HR STEAM, TOTAL.
ASSUME ALL AUTOCLAVES OPERATE 4 HRS/DAY, 5 DAYS/WEEK
ASSUME 60°F MAKE-UP; NO CONDENSATE RETURN.
STANDBY USE AVERAGES 65 LBS/HR.

Total annual use = 2292 MBtu/yr (see p. BP1B-2)

TO REDUCE THE STEAM PRESSURE TO 30psig, AN ALTERNATIVE SOURCE OF STEAM WILL HAVE TO BE PROVIDED TO SERVE THE AUTOCLAVES; AND, THEIR LOAD WILL NO LONGER BE CARRIED BY THE BOILER PLANT.

ASSUME ENERGY IS PROVIDED BY DEDICATED ELECTRICAL BOILER @ 95% EFFICIENCY.

RS&H

SUBJECT Ft Gordon Hospital
DESIGNER GWF
CHECKER
AEP NO
SHEET OF
DATE 2-14-96
DATE

ELECTRICAL ENERGY FOR AUTOCLAVES

$E = 2292 \text{ MBTU/yr} / 0.95$

$= \underline{2413} \text{ MBTU/yr} = \underline{706,900} \text{ KWh/yr}$

— this additional energy use and cost.

CALC NAT. GAS ENERGY SAVINGS

steam load due to autoclaves = 2292 MBTU/yr.

GAS ENERGY SAVINGS FROM REDUCED PRESSURE

FY95 NATURAL GAS CONSUMPTION = 78,011 MBTU

$\eta_{60} = 80.6\ \%$

$\eta_{30} = 81.4\ \%$

Use 20% less due to Renovation Project (78,011 * 0.8) = 62,409 MBTU

$Q_{60\text{-}30} = 62,409 - [62,409 * 0.806 - 2292] \div 0.814$

$= \underline{3432} \text{ MBTU/yr}$

CONSTRUCTION COST ESTIMATE

Project:
Location: Fort Gordon, GA
Basis: Schematic Design
Building: N/A

RS&H No.:
Date: 3/5/96
Estimator: G.W.FALLON
Filename: eco bp1b.xls

ITEM DESCRIPTION	QUANTITY No.	Unit	MATERIAL/EQUIP $/Unit	Total	LABOR $/Unit	Total	TOTAL COST	SOURCE Material	Labor
								MMp	MMp
Elec. Boiler									
1.023MBtuh	1	ea	15900	15900	1675	1675	17575	206	206
2.5"dia pipe SE	100	ft	7.1	710	8.65	865	1575	142	142
2.5"dia El SE	10	ea	16	160	31	310	470	145	145
2.5" dia "T" SE	2	ea	23	46	48	96	142	150	150
2.5"dia Globe Vlv.	4	ea	287	1148	29	116	1264	188	188
Subtotal Bare Costs				17964		3062	$21,026		
Retrofit Cost Factors			0%	0	0%	0	$0	MMp6	MMp6
				-		-	-		
Subtotal				17964		3062	21,026		
City Cost Index (Aug. GA)			0%	0	-46%	-1409	-1,409	MMp533	MMp533
				-		-	-		
Subtotal				17964		1653	19,617		
OH & Profit Markups			10%	1796	53%	876	2,672	MMp7	MMp475
				-		-	-		
Subtotal				19760		2529	22,289		
Sales Taxes			6.0%	1186		NA	1,186	MMp476	
				-		-	-		
Subtotal				20946		2529	23,475		
Contingency			10%	2095	10%	253	2,348	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				23041		2782	25,823		
Design Fee				NA	6.0%	1409	1,409		
SIOH				NA	6.0%	1409	1,409		
				-		-	-		
Total Project Cost				23041		5600	28,641		

LEGEND:
MMp### 1996 Means Mechanical Cost Data, page ###.

BP1 -3

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: BP1
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BP1 REDUCE STEAM PRESSURE
FISCAL YEAR 1996 DISCRETE PORTION NAME: 60 TO 30 PSIG
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 25800.	
B. SIOH	$ 1548.	
C. DESIGN COST	$ 1548.	
D. TOTAL COST (1A+1B+1C)	$ 28896.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 28896.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	-2413.	$ -18387.	13.68	$ -251535.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	3432.	$ 9266.	17.25	$ 159845.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		1019.	$ -9121.		$ -91690.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ -9121.

5. SIMPLE PAYBACK PERIOD (1G/4) -3.17 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ -91690.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= -3.17
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

EISENHOWER ARMY MEDICAL CENTER
STERILIZER STEAM USE
FILENAME: STERL.WK4

Manufacturer/Model	Location	#	Average Steam Use (lbs/hr)	(lbs/cyc)	Standby Use (lbs/hr)	Weekday (lbs/da)	Weekend (lbs/da)
Castle (MDT) 3525	OR	2	96	-	-	768	0
AMSCO V116	OR	1	-	18	7	428	168
AMSCO 3000 (1)	OR	1	130	-	13	780	312
AMSCO 3012	CMS	2	56	-	-	448	0
AMSCO 3000/3 Vac.,Med.	CMS	2	185	-	19	2220	888
AMSCO Reliance (Cart Washer) (2	CMS	1	180	-	-	720	0
Castle (MDT) 3522	Dental	1	96	-	12	624	288
AMSCO V116	L & D (3)	1	-	18	7	428	168
AMSCO 444	CMS	1	-	18	7	428	168
Totals		12	743	54	65	6844	1992
Totals (gal/da)						825	240
Annual Totals (MBtu/yr)						2053	239
Grand Annual Total (MBtu/yr)						2292	

Utilization Factor = 0.50

(1) 90 to 180 lbs/hr
(2) 98 to 185 lbs/hr
(3) Labor and Delivery

COMBUSTION CALCULATIONS

INPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 11:01 AM
Firetube,90 psig, Sat,10%Excess Air, 80% Eff.

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.67
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	476
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.00
UNACCOUNTABLE LOSS (%)	1.00
ENTHALPY ADDED IN BOILER (BTU/LB)	1000

FANS

	STAT.PRES (IN.H2O)	EFFICIENCY (%)	AIR SUPPLIED (% TOT.)	TEST BLOCK FLOW (%)	TEST BLOCK STATIC (%)
PRIMARY	5.0	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	0.0	85.0		25	56

COMBUSTION CALCULATIONS

OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 11:01 AM
Firetube,90 psig, Sat,10%Excess Air, 80% Eff.

HEAT LOSSES	MBTU /HR	PERCENT
IN DRY FLUE GAS	1.42	7.37
FROM H2O IN AIR	0.04	0.19
FROM H20 IN FUEL--SENSIBLE	0.33	1.72
FROM H20 IN FUEL--LATENT	1.87	9.72
TOTAL IN WET FLUE GAS	3.66	19.00
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABLE	0.19	1.00
TOTAL	3.85	20.00

BOILER EFFICIENCY (%)	80.00
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.18
SPEC.VOL.OF WET FLUE GAS (CU.FT./LB)	24.69
AIR TO FUEL RATIO (LB AIR/LB FUEL)	18.93
COMB. AIR SPECIFIC VOL. (CU.FT/LB)	13.712
COMBUSTION AIR FLOW (LBS/HR)	15447

FLUE GAS ANALYSIS

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.53
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.11	1.98	2.26
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.83	87.34	72.09	82.21
H2O	18.90		12.31	

COMBUSTION CALCULATIONS
OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 11:01 AM
Firetube,90 psig, Sat,10%Excess Air, 80% Eff.

FLUE GAS FLOWS

	WET	DRY
MASS (LBS/HR)	16253	14252
VOLUME (ACFM)	6687	5423
(SCFM)(70DEG.F.)	3788	3072
@ 12% CO2	5309	3492
"F" FACTOR (DSCF/MMBTU @12% CO2)		10884

FAN DATA

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15447	3530	3.39	16992	3883	4.47
SECONDARY	0	0	0	0	0	0
INDUCED	16253	6687	0	20316	8359	0

BPI-8

COMBUSTION CALCULATIONS
INPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:59 AM
Firetube,60 psig, Sat,10%Excess Air

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.53
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	453
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.00
UNACCOUNTABLE LOSS (%)	1.00
ENTHALPY ADDED IN BOILER (BTU/LB)	993

FANS

	STAT.PRES (IN.H2O)	EFFICIENCY (%)	AIR SUPPLIED (% TOT.)	TEST BLOCK FLOW (%)	TEST BLOCK STATIC (%)
PRIMARY	5.0	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	0.0	85.0		25	56

COMBUSTION CALCULATIONS

OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:59 AM
Firetube,60 psig, Sat,10%Excess Air

HEAT LOSSES	MBTU /HR	PERCENT
IN DRY FLUE GAS	1.31	6.91
FROM H2O IN AIR	0.03	0.18
FROM H20 IN FUEL--SENSIBLE	0.31	1.61
FROM H20 IN FUEL--LATENT	1.85	9.72
TOTAL IN WET FLUE GAS	3.50	18.42
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABLE	0.19	1.00
TOTAL	3.69	19.42

BOILER EFFICIENCY (%)	80.58
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.18
SPEC.VOL.OF WET FLUE GAS (CU.FT./LB)	24.08
AIR TO FUEL RATIO (LB AIR/LB FUEL)	18.93
COMB. AIR SPECIFIC VOL. (CU.FT/LB)	13.712
COMBUSTION AIR FLOW (LBS/HR)	15229

FLUE GAS ANALYSIS

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.53
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.11	1.98	2.26
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.83	87.34	72.09	82.21
H2O	18.90		12.31	

COMBUSTION CALCULATIONS
OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:59 AM
Firetube,60 psig, Sat,10%Excess Air

FLUE GAS FLOWS

	WET	DRY
MASS (LBS/HR)	16023	14050
VOLUME (ACFM)	6430	5215
(SCFM)(70DEG.F.)	3734	3028
@ 12% CO2	5234	3442
"F" FACTOR (DSCF/MMBTU @12% CO2)		10884

FAN DATA

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15229	3480	3.34	16752	3828	4.41
SECONDARY	0	0	0	0	0	0
INDUCED	16023	6430	0	20029	8038	0

COMBUSTION CALCULATIONS
INPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:54 AM
Firetube,30 psig, Sat,10%Excess Air

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.35
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	419
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY.RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.00
UNACCOUNTABLE LOSS (%)	1.00
ENTHALPY ADDED IN BOILER (BTU/LB)	985

FANS

	STAT.PRES (IN.H2O)	EFFICIENCY (%)	AIR SUPPLIED (% TOT.)	TEST BLOCK FLOW (%)	TEST BLOCK STATIC (%)
PRIMARY	5.0	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	0.0	85.0		25	56

BPI - 12

COMBUSTION CALCULATIONS

OUTPUT

CLIENT: C.O.E.

DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr.
Firetube,30 psig, Sat,10%Excess Air

TIME: 10:54 AM

HEAT LOSSES	MBTU /HR	PERCENT
IN DRY FLUE GAS	1.16	6.24
FROM H2O IN AIR	0.03	0.16
FROM H20 IN FUEL--SENSIBLE	0.27	1.45
FROM H20 IN FUEL--LATENT	1.81	9.72
TOTAL IN WET FLUE GAS	3.27	17.57
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABLE	0.19	1.00
TOTAL	3.46	18.57

BOILER EFFICIENCY (%)	81.43
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.18
SPEC.VOL.OF WET FLUE GAS (CU.FT./LB)	23.18
AIR TO FUEL RATIO (LB AIR/LB FUEL)	18.93
COMB. AIR SPECIFIC VOL. (CU.FT/LB)	13.712
COMBUSTION AIR FLOW (LBS/HR)	14945

FLUE GAS ANALYSIS

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.53
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.11	1.98	2.26
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.83	87.34	72.09	82.21
H2O	18.90		12.31	

COMBUSTION CALCULATIONS
OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:54 AM
Firetube,30 psig, Sat,10%Excess Air

FLUE GAS FLOWS

	WET	DRY
MASS (LBS/HR)	15724	13788
VOLUME (ACFM)	6075	4927
(SCFM)(70DEG.F.)	3664	2972
@ 12% CO2	5137	3378
"F" FACTOR		
(DSCF/MMBTU @12% CO2)		10884

FAN DATA

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	14945	3415	3.28	16439	3757	4.32
SECONDARY	0	0	0	0	0	0
INDUCED	15724	6075	0	19655	7594	0

BP1-14

RS&H

SUBJECT ____________________ AEP NO ____________

____________________ SHEET ______ OF ______

DESIGNER ____________________ DATE ____________

CHECKER ____________________ DATE ____________

Sterilizer Steam Use

#	Manufacturer	Loc	Avg (lbs/hr)	Standby Use (lb/hr)
2	Castle (MDT) 3525	OR	96	-
1	AMSCO V116	OR	18 lb/cy [1]	7
1	AMSCO 3000	OR		
2	AMSCO 3012	CMS	56	-
2	AMSCO 3000/3 (Vac. Md)	CMS	185	10
1	AMSCO Reliance Cart Washer)	CMS	90-180/cyc [1]	-
1	CASTLE 3522	Dental	96	12
1	AMSCO V116	LED	18 lb/cyc [1]	7
1	AMSCO 444	CMS	18 lb/cyc [1]	-

(1) 15 min cycle

ELECTRICAL SG'S NOT ACCEPTABLE

OR

		Steam Avg (lb/hr)	STANDBY	Press Reg. psig
	2 castle (MDT) 3525 series (flash)	96 lb/hr	–	50
	1 AMSCO V116	18 lb/cy	7	50-8
	1 " 3000 (small/medium)	98/185	10%	50-8

CMS.

x16x26"	2 AMSCO 3012 no jacket (WASHER/STERILIZER)	56	–	50-8
4'x36x60"	2 AMSCO 3000/3 (2dr) (VBC) (Med.)	185	10%	50-80
	1 AMSCO RELIANCE (CART WASHER)	47-126/cycle	–	50-60

DENTAL

6-12 lbs/min 4cy/hr 15min/cy

1 CASTLE 3522 (flash)	96	12	50

LED – PART TIME.

1 AMSCO V116	18 lb/cy	7

CMS

1 INST. WASHER AMSCO 444 has return	18 lb/cycle 15 min/cycle	–	30-8

AMSCO – 800 333 8848
8828
MDT – 800 950 9912

MOSTLY USED 40 HR/wk – 5-8's. FOR STERILIZATION.
ESTIMATE 90% availability

Sgt. Rail / Ackerman – Med. Maint. (706) 787-8242

RS&H®

Telephone Call Confirmation

Project Number ______ (800) 950 - 9912

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 6/24/96

Conversed with Jimmy Adams Of MDT

Regarding Steam Use

Distribution:

BPI - 17

RS&H

Telephone Call Confirmation

Project Number (800) 333 - 8848

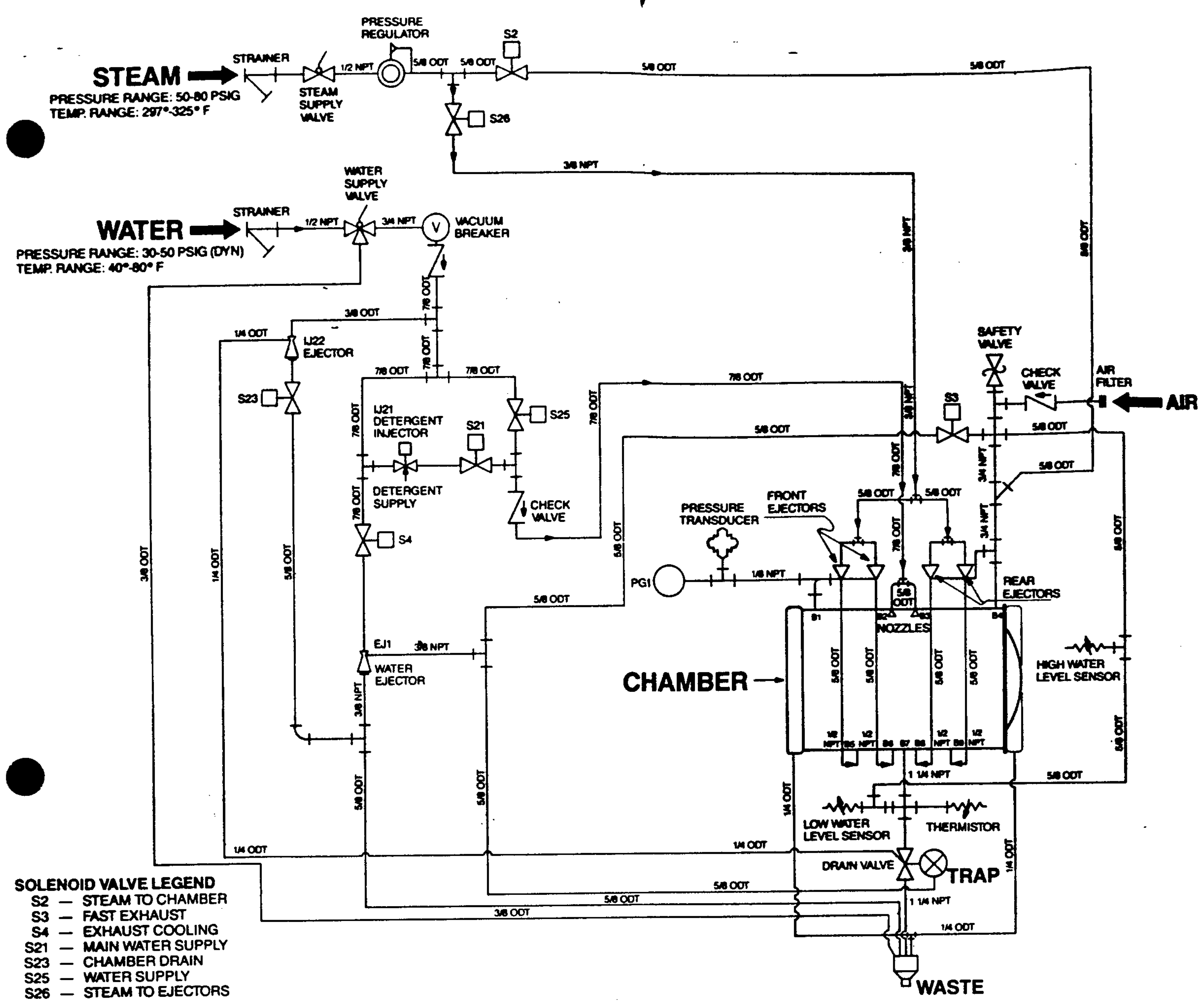
Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 6/24/96

Conversed with Greg Of Amsco

Regarding Avg steam use and standby use

Distribution:

BP1-18



SOLENOID VALVE LEGEND

- S2 — STEAM TO CHAMBER
- S3 — FAST EXHAUST
- S4 — EXHAUST COOLING
- S21 — MAIN WATER SUPPLY
- S23 — CHAMBER DRAIN
- S25 — WATER SUPPLY
- S26 — STEAM TO EJECTORS

Piping

BP1-19

RS&H

SUBJECT Ft. Gordon Hospital
DESIGNER GWF
CHECKER
AEP NO
SHEET OF
DATE 2-19-96
DATE

BP-3 Increase Boiler Efficiency

THE EXISTING BOILER CONTROLS REQUIRE IMMEDIATE ATTENTION. THE SYSTEM SEEMS TO BE SIGNIFICANTLY UNDER DAMPED. THE PRESSURE SWINGING AND LOAD SWINGING IS EXCESSIVELY WIDE. THE DRUM WATER LEVEL IS NEARLY OUT OF CONTROL ON TWO OF THE UNITS.

THE BOILER CONTROLS NEED TUNING BY A QUALIFIED INSTRUMENT TECHNICIAN KNOWLEDGEABLE IN THE INSTALLED BOILER CONTROL LOOPS. NO ANALOG DIAGRAMS (CONTROL LOOP DIAGRAMS) COULD BE FOUND IN THE FACILITY. NO ONE KNEW IF THE DRUM LEVEL CONTROL LOOP WAS SINGLE, DOUBLE, OR TRIPLE ELEMENT. IN ONE CASE, BOILER NO.3, THE FEEDWATER VALVE WOULDN'T COMPLETELY CLOSE EVEN WHEN THE OPERATOR TRIED TO CLOSE IT.

DURING SOME OF THE SWINGS STACK O_2 VARIED FROM 2.1% TO 14%.

STACK LOSS

	O_2%	STACK LOSS (MBTU/HR)	EFF (%)
	2.1	4.11	78.3
	14.0	7.93	58.7
AVG	8.05	6.02	68.5
	1.7		78.6

ENERGY SAVINGS = 66,400 MBtu/yr * (0.786 - 0.685) = 6706 MBtu/yr.
(use based on TRACE run after renovation project)

COMBUSTION CALCULATIONS

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CLIENT	RSH	DATE	06-Mar-96
PLANT	Ft. Gordon Hospital 90 psig & 2.1% O2	TIME	03:56 PM

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.76
TOTAL AIR ASSIGNED (%)	113
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	551
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.50
UNACCOUNTABLE LOSS (%)	0.00
ENTHALPY ADDED IN BOILER (BTU/LB)	992

F A N S	STAT.PRES (IN.H2O)	EFFICIENCY (%)	IR SUPPLIE (% TOT.)	T.B.FLOW (%)	T.B.STAT (%)
PRIMARY	7.5	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	5.0	85.0		25	56

BP3-2

COMBUSTION CALCULATIONS

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CLIENT	RSH	DATE	06-Mar-96
PLANT	Ft. Gordon Hospital 90 psig & 2.1% O2	TIME	03:56 PM -

HEAT LOSSES	MMBTU/HR	PERCENT
IN DRY FLUE GAS	1.77	9.12
FROM H2O IN AIR	0.05	0.24
FROM H2O IN FUEL--SENSIBLE	0.40	2.08
FROM H2O IN FUEL--LATENT	1.89	9.72
TOTAL IN WET FLUE GAS	4.11	21.16
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABL	0.10	0.50
TOTAL	4.21	21.66

BOILER EFFICIENCY (%)	78.34
STEAM GENERATED (LBS/HR)	15356
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.62
SPEC.VOL.OF WET FLUE GAS (CU.FT	26.66
AIR TO FUEL RATIO (LB AIR/LB FU	19.36
COMB. AIR SPECIFIC VOL. (CU.FT/	13.712
COMBUSTION AIR FLOW (LBS/HR)	15962

F L U E G A S A N A L Y S I S

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.38	10.29	13.33	15.16
SO2	0.0000	0.0000	0.0000	0.0000
O2	2.10	2.58	2.43	2.76
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.96	87.13	72.17	82.08
H2O	18.55		12.07	

F L U E   G A S   F L O W S

	WET	DRY
MASS (LBS/HR)	16775	14750
VOLUME (ACFM)	7454	6071
(SCFM)(70DEG.F	3906	3182
@ 12% CO	5592	3709
"F" FACTOR (DSCF/MMBTU @12% CO2)		11448

F A N   D A T A

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15962	3648	5	17558	4012	7
SECONDARY	0	0	0	0	0	0
INDUCED	16775	7454	7	20969	9318	13

COMBUSTION CALCULATIONS

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CLIENT	RSH	DATE	06-Mar-96
PLANT	Ft. Gordon Hospital 90 psig & 14% O2	TIME	03:47 PM

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.76
TOTAL AIR ASSIGNED (%)	337
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	551
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.50
UNACCOUNTABLE LOSS (%)	0.00
ENTHALPY ADDED IN BOILER (BTU/LB)	992

F A N S	STAT.PRES (IN.H2O)	EFFICIENCY (%)	IR SUPPLIE (% TOT.)	T.B.FLOW (%)	T.B.STAT (%)
PRIMARY	7.5	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	5.0	85.0		25	56

BP3-5

COMBUSTION CALCULATIONS

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CLIENT	RSH	DATE	06-Mar-96
PLANT	Ft. Gordon Hospital 90 psig & 14% O2	TIME	03:47 PM

HEAT LOSSES	MMBTU/HR	PERCENT
IN DRY FLUE GAS	5.50	28.29
FROM H2O IN AIR	0.14	0.71
FROM H2O IN FUEL--SENSIBLE	0.40	2.08
FROM H2O IN FUEL--LATENT	1.89	9.72
TOTAL IN WET FLUE GAS	7.93	40.81
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABL	0.10	0.50
TOTAL	8.03	41.31

BOILER EFFICIENCY (%)	58.69
STEAM GENERATED (LBS/HR)	11505
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	59.70
SPEC.VOL.OF WET FLUE GAS (CU.FT	26.02
AIR TO FUEL RATIO (LB AIR/LB FU	57.94
COMB. AIR SPECIFIC VOL. (CU.FT/	13.712
COMBUSTION AIR FLOW (LBS/HR)	47757

F L U E   G A S   A N A L Y S I S

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	2.97	3.22	4.60	4.85
SO2	0.0000	0.0000	0.0000	0.0000
O2	14.00	15.20	15.80	16.63
HCL	0.0000	0.0000	0.0000	0.0000
N2	75.13	81.58	74.58	78.52
H2O	7.91		5.02	

BP3-6

F L U E   G A S   F L O W S

	WET	DRY
MASS (LBS/HR)	48571	46131
VOLUME (ACFM)	21067	19401
(SCFM)(70DEG.F	11040	10167
@ 12% CO	44663	37879
"F" FACTOR (DSCF/MMBTU @12% CO2)		116907

F A N   D A T A

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	47757	10914	16	52533	12005	21
SECONDARY	0	0	0	0	0	0
INDUCED	48571	21067	19	60714	26334	38

COMBUSTION CALCULATIONS

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CLIENT	RSH	DATE	05-Mar-96
PLANT	Ft. Gordon Hospital 90 psig @ 1.7% O_2	TIME	10:42 AM

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.76
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	551
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.50
UNACCOUNTABLE LOSS (%)	0.00
ENTHALPY ADDED IN BOILER (BTU/LB)	992

F A N S	STAT.PRES (IN.H2O)	EFFICIENCY (%)	IR SUPPLIE (% TOT.)	T.B.FLOW (%)	T.B.STAT (%)
PRIMARY	7.5	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	5.0	85.0		25	56

COMBUSTION CALCULATIONS

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O U T P U T- U T P U   U T P U   U T P U T   U T P U T O U T P U T-
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CLIENT	RSH	DATE	05-Mar-96
PLANT	Ft. Gordon Hospital 90 psig @ 1.7% O_2	TIME	10:42 AM

HEAT LOSSES	MMBTU/HR	PERCENT
IN DRY FLUE GAS	1.73	8.90
FROM H2O IN AIR	0.05	0.23
FROM H2O IN FUEL--SENSIBLE	0.40	2.08
FROM H2O IN FUEL--LATENT	1.89	9.72
TOTAL IN WET FLUE GAS	4.07	20.94
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABL	0.10	0.50
TOTAL	4.17	21.44

BOILER EFFICIENCY (%)	78.56
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.17
SPEC.VOL.OF WET FLUE GAS (CU.FT	26.68
AIR TO FUEL RATIO (LB AIR/LB FU	18.92
COMB. AIR SPECIFIC VOL. (CU.FT/	13.712
COMBUSTION AIR FLOW (LBS/HR)	15597

F L U E   G A S   A N A L Y S I S

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.54
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.10	1.97	2.25
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.82	87.34	72.09	82.21
H2O	18.91		12.31	

F L U E G A S F L O W S

	WET	DRY
ASS (LBS/HR)	16410	14390
OLUME (ACFM)	7298	5918
(SCFM)(70DEG.F.)	3824	3101
@ 12% CO	5360	3525
"F" FACTOR (DSCF/MMBTU @12% CO2)		10879

F A N D A T A

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15597	3564	5	17157	3921	7
SECONDARY	0	0	0	0	0	0
INDUCED	16410	7298	7	20513	9123	13

CONSTRUCTION COST ESTIMATE

Project:	Modify boiler Coltrols	RS&H No.:	6941331005
Location:	Fort Gordon, GA	Date:	3/6/96
Basis:	Schematic Design	Estimator:	G.W.FALLON
Building:	EISENWOWER ARMY MEDICAL CENTER	Filename:	BP-12.xls

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL COST	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total		Material	Labor
								MMp	MMp
Tune combustion controls									
3 loops per boiler	9	ea		0	2932.5	$ 26,393	$ 26,393		318
Subtotal Bare Costs				$ -		$ 26,393	$ 26,393		
Retrofit Cost Factors			0%	$ -	0%	$ -	$ -	MEp6	MEp6
				-		-	-		
Subtotal				$ -		$ 26,393	$ 26,393		
City Cost Index (Aug. GA)			0%	$ -	-46%	$ (12,141)	$ (12,141)	MMp533	MMp533
				-		-	-		
Subtotal				$ -		$ 14,252	$ 14,252		
OH & Profit Markups			10%	$ -	53%	$ 7,554	$ 7,554	MMp7	MMp7
				-		-	-		
Subtotal				$ -		$ 21,806	$ 21,806		
Sales Taxes			6.0%	$ -		NA	$ -	MMp476	
				-		-	-		
Subtotal				$ -		$ 21,806	$ 21,806		
Contingency			10%	$ -	10%	$ 2,181	$ 2,181	MMp6	
				-		-	-		
Subtotal construction Cost				$ -		$ 23,987	$ 23,987		
Design Fee				NA	6.0%	$ 1,308	$ 1,308		
SIOH				NA	6.0%	$ 1,308	$ 1,308		
				-		-	-		
Total Project Cost				$ -		$ 26,603	$ 26,603		

LEGEND:

MMp### 1996 Means Mechanical Cost Data, page ###.

MEp### 1996 Means Electrical Cost Data, page ###.

BP3-11

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: BP3
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BP3 INCREASE BOILER EFFICIENCY
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 03-13-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 24000.	
B. SIOH	$ 1440.	
C. DESIGN COST	$ 1440.	
D. TOTAL COST (1A+1B+1C)	$ 26880.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 26880.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	0.	$ 0.	13.68	$ 0.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	6706.	$ 18106.	17.25	$ 312332.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		6706.	$ 18106.		$ 312332.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 18106.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.48 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 312332.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 11.62
(IF < 1 PROJECT DOES NOT QUALIFY)

RS&H	SUBJECT Ft. Gordon Hospital
	ECO - BP7
	DESIGNER G.W.F
	CHECKER
	AEP NO 4941331005
	SHEET ____ OF ____
	DATE 2-15-96
	DATE

ECO BP7 INSTALL ECONOMIZER

ANNUAL GAS ENERGY CONSUMMED 78,011 MBTU/yr

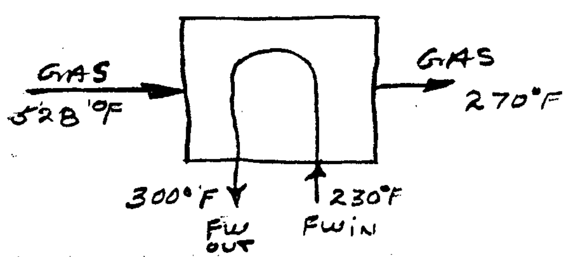
ANNUAL STACK LOSS

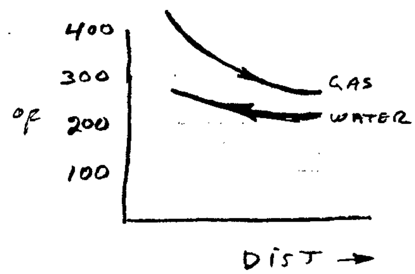
COMBUSTION CALC'S SHOW 20.32 % STACK LOSS (60psig)

DETERMINE ECONOMIZER OPERATING TEMPERATURES

ASSUME 40° COLD END APPROACH.

ECONOMIZER





MAX RECOVERABLE HEAT PER BOILER (SEE pg 3 BOILER CALC'S 60psig)

$Q = w\,c_p\,\Delta T$

$= 16183$ LBS FLUE GAS/HR × 0.26 BTU/# °F × (528 - 270)

$= 1{,}086$ MBTU/HR

DETERMINE WATER OUTLET TEMP.

$Q_w = Q_{gas} = W\,c_p\,\Delta T$

$1{,}086{,}000 = 15400 \times 1 \times (T_{OUT} - 230)$

$T_{OUT} = 300\ °F$

AVERAGE HOURLY USE RATE

66,400 MBTU/yr / 8760 H/y = 7.58 MBTU/HR.

(use based on TRACE run after renovation project)

LOAD FACTOR

STACK LOSS = 20.32 % ENERGY INPUT

FULL LOAD STACK LOSS = 3.90 MBTU/HR

$\dfrac{7.58 \times 0.2032}{3.90} = 0.388$

RS&H

SUBJECT Ft. Gordon Hospital
ECO BP-7
DESIGNER GWF
CHECKER

AEP NO
SHEET ____ OF ____
DATE 2-15-96
DATE

MAX ANNUAL RECOVERABLE ENERGY FROM STACK

$Q_L = \underline{1.086 \text{ MBTU/HR} \times 0.388 \times 8760 \text{ Hr/yr}}$

$= \underline{\underline{3691}} \text{ MBtu/yr}$

ID FAN HP
ASSUME 5" TDH @ 0.464 LOAD FACTOR

$Hp = \frac{Vh}{6356\,\eta} = \frac{7028 \text{ ACFM} \times 5}{6356 \times 0.7} \times 0.464 = 3.66 \text{ HP}$

$3.57 \text{ HP} \times 0.746 \text{ KW/Hp} = 2.73 \text{ kw}$

ANNUAL ID FAN ENERGY CONSUMPTION

$Kwh = 2.73 \text{ kw} \times 8760 \text{ Hr/yr}$
$= \boxed{23900 \text{ kwh./yr}}$

$Q = \frac{23900 \text{ kwh/yr} \times 3413 \text{ BTU/kwh}}{1 \times 10^6 \text{ BTU/MBTU}}$
$= \boxed{81.57 \text{ MBTU/yr}}$

COMBUSTION CALCULATIONS

************ ******** ********* ********** ********** ************
I N P U T- N P U T I N P U T I N P U T- I N P U T- I N P U T-
************ ******** ********* ********** ********** ************

CLIENT	RSH	DATE	05-Mar-96
PLANT	Ft. Gordon Hospital 60 psig	TIME	10:58 AM

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.63
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	528
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.50
UNACCOUNTABLE LOSS (%)	0.00
ENTHALPY ADDED IN BOILER (BTU/LB)	986

F A N S	STAT.PRES (IN.H2O)	EFFICIENCY (%)	IR SUPPLIE (% TOT.)	T.B.FLOW (%)	T.B.STAT (%)
PRIMARY	7.5	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	5.0	85.0		25	56

BP7-3

COMBUSTION CALCULATIONS

************ ******** ********* ********** ********** ************
O U T P U T- U T P U   U T P U   U T P U T   U T P U T O U T P U T-
************ ******** ********* ********** ********** ************

CLIENT	RSH	DATE	05-Mar-96
PLANT	Ft. Gordon Hospital 60 psig	TIME	10:58 AM

HEAT LOSSES	MMBTU/HR	PERCENT
IN DRY FLUE GAS	1.61	8.42
FROM H2O IN AIR	0.04	0.22
FROM H2O IN FUEL--SENSIBLE	0.38	1.96
FROM H2O IN FUEL--LATENT	1.86	9.72
TOTAL IN WET FLUE GAS	3.90	20.32
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABL	0.10	0.50
TOTAL	3.99	20.82

BOILER EFFICIENCY (%)	79.18
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.17
SPEC.VOL.OF WET FLUE GAS (CU.FT	26.06
AIR TO FUEL RATIO (LB AIR/LB FU	18.92
COMB. AIR SPECIFIC VOL. (CU.FT/	13.712
COMBUSTION AIR FLOW (LBS/HR)	15381

F L U E   G A S   A N A L Y S I S

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.54
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.10	1.97	2.25
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.82	87.34	72.09	82.21
H2O	18.91		12.31	

F L U E   G A S   F L O W S

	WET	DRY
ASS (LBS/HR)	16183	14190
OLUME (ACFM)	7028	5699
(SCFM)(70DEG.F.)	3771	3058
@ 12% CO	5286	3476
"F" FACTOR		
(DSCF/MMBTU @12% CO2)		10879

F A N   D A T A

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15381	3515	5	16919	3866	7
SECONDARY	0	0	0	0	0	0
INDUCED	16183	7028	7	20228	8785	13

CONSTRUCTION COST ESTIMATE

Project:	Install Economizer	RS&H No.:	6941331005
Location:	Fort Gordon, GA	Date:	3/6/96
Basis:	Schematic Design	Estimator:	G.W.FALLON
Building:	EISENWOWER ARMY MEDICAL CENTER	Filename:	BP7.xls

ITEM DESCRIPTION	QUANTITY No.	Unit	MATERIAL/EQUIP $/Unit	Total	LABOR $/Unit	Total	TOTAL COST	SOURCE Material	Labor
								MMp	MMp
Economizer	3	ea	$ 18,200	$ 54,600	$ 400	$ 1,200	$ 55,800	Quote	230
Pipe- 2.5" dia									
Sch 40 WE	150	ft	$ 3.91	$ 587	$ 5.61	$ 842	$ 1,429	140	140
Flange-2.5" dia									
150 lb WE	6	ea	$ 18.90	$ 113	$24.13	$ 145	$ 258	164	164
Duct-transition									
Square to Round									
36"x36"-28"dia 200lbs ea	6	ea	$ 506.00	$ 3,036	$1,620	$ 9,720	$ 12,756	294	294
Thermowell	12	ea	$ 29.00	$ 348	$17.15	$ 206	$ 554	167	167
Bypass duct	300	lb	$ 1.05	$ 315	$ 2.65	$ 795	$ 1,110	$ 294	$ 294
Bybass Damper	9	ea	$ 49.00	$ 441	$21.00	$ 189	$ 630	329	329
IDFan	3	ea	$ 3,990	$ 11,970	$ 208	$ 624	$ 12,594	219	219
Subtotal Bare Costs				$ 71,410		$ 13,721	$ 85,131		
Retrofit Cost Factors			0%	$ -	0%	$ -	$ -	MEp6	MEp6
				-		-	-		
Subtotal				$ 71,410		$ 13,721	$ 85,131		
City Cost Index (Aug. GA)			0%	$ -	-46%	$ (6,312)	$ (6,312)	MMp533	MMp533
				-		-	-		
Subtotal				$ 71,410		$ 7,409	$ 78,819		
OH & Profit Markups			10%	$ 7,141	53%	$ 3,927	$ 11,068	MMp7	MMp7
				-		-	-		
Subtotal				$ 78,551		$ 11,336	$ 89,887		
Sales Taxes			6.0%	$ 4,713		NA	$ 4,713	MMp476	
				-		-	-		
Subtotal				$ 83,264		$ 11,336	$ 94,600		
Contingency			10%	$ 8,326	10%	$ 1,134	$ 9,460	MMp6	
				-		-	-		
Subtotal construction Cost				$ 91,590		$ 12,470	$ 104,060		
Design Fee				NA	6.0%	$ 5,676	$ 5,676		
SIOH				NA	6.0%	$ 5,676	$ 5,676		
				-		-	-		
Total Project Cost				$ 91,590		$ 23,822	$ 115,412		

LEGEND:

MMp### 1996 Means Mechanical Cost Data, page ###.

MEp### 1996 Means Electrical Cost Data, page ###.

BP7-6

IEC
since 1939

ILLINGWORTH ENGINEERING COMPANY

6855 Phillips Parkway Drive South • Jacksonville, Florida 32256

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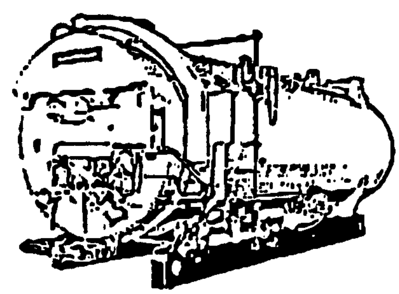
manufacturers agent

FAX TRANSMITTAL



DATE: 2.16.96

TO: RS&H

ATTN: GEORGE FALLON

FAX NO: 279-2489

FROM: MIKE PLOEG

PAGES: 2 (Including Cover Sheet)

RE: FT. GORDON

MESSAGE:

#1 CAIN MODEL BTR-136D28SSS $18200

#3 O^2 TRIM SYSTEM GAS/#2 OIL $17600

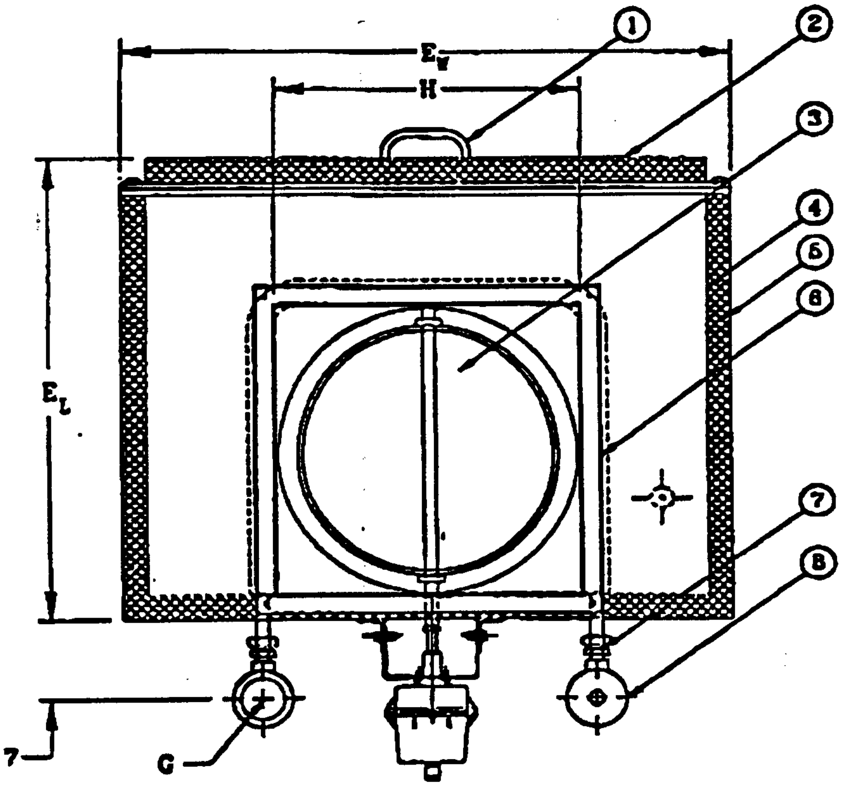
IF YOU DID NOT RECEIVE ALL THE PAGES, PLEASE CALL BACK AS SOON AS POSSIBLE.

BP 7-1

SUBMITTAL

DATE: 03/07/95 REF#: 90658 FOR: Energizer Products
MODEL: RTR-136D28SSS C/O: Cain Industries
HEAT SOURCE: 500 HP Boiler

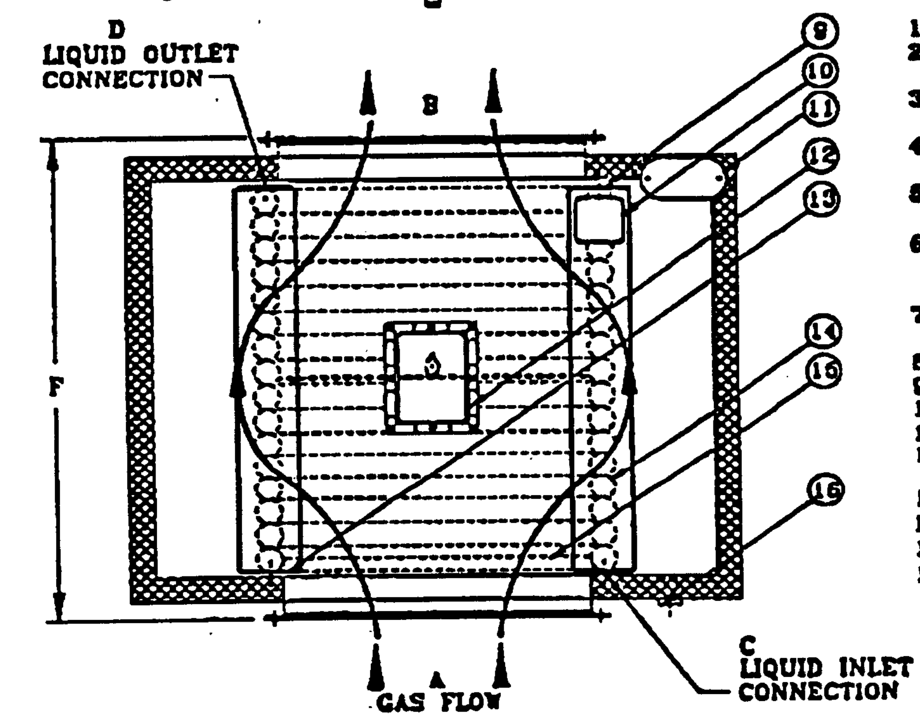
Bul.#22153



RTR

PERFORMANCE AND DIMENSION DATA

A.	360'F	
B.	244'F	
C.	85'F	
D.	121'F	
E.	60x50"	
F.	41.50"	
G.	2"	CONN.
H.	36x36"	CONN.
	1367#	WGT
	404	H.S.
	250	PSIG
	750	TEMP.



PARTS LIST
(SEE DESIGN DATA FOR CONSTRUCTION)

1. DOOR HANDLE
2. INSPECTION DOOR FOR TUBE CLEANING
3. STAINLESS STEEL FLUE GAS BYPASS
4. STAINLESS STEEL INTERIOR
5. 2" THICKNESS INSULATION: 3" ☐ (OPTIONAL)
6. GAS FLANGE CONNECTION: 2 x 2" ANGLE (STANDARD) 3 x 3" ANGLE: ☐ (OPTIONAL)
7. COMPRESSION FITTING FOR TUBE REMOVAL
8. HEADER MANIFOLD
9. NPT VENT (3/4")
10. ASME STAMP: ☐ (OPTIONAL)
11. CAIN INDUSTRIES LOGO
12. MODULATING DAMPER ACTUATOR: ☐ (OPTIONAL)
13. NPT FEMALE DRAIN (3/4")
14. REMOVABLE FIN TUBE ROWS
15. DRAIN CATCH RING
16. 1" NPT CONDENSATE DRAIN

CAIN INDUSTRIES, Inc. P.O.Box 189 Germantown,WI 53022 414-251-0051 800-558-8690 Fax:414-251-0118

BP7-8

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: BP7
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BP7 BOILER ECONOMIZER
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 03-13-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 104100.		
B. SIOH	$ 6246.		
C. DESIGN COST	$ 6246.		
D. TOTAL COST (1A+1B+1C)	$ 116592.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 116592.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	-82.	$ -625.	13.68	$ -8548.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	3691.	$ 9966.	17.25	$ 171908.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		3609.	$ 9341.		$ 163361.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 9341.

5. SIMPLE PAYBACK PERIOD (1G/4) 12.48 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 163361.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.40
(IF < 1 PROJECT DOES NOT QUALIFY)

ECO BP8 INSTALL AIR HEATER

ANNUAL STACK LOSS

15,852 MBTU/yr (SEE ECO-BP7)

MAX RECOVERABLE HEAT PER BOILER

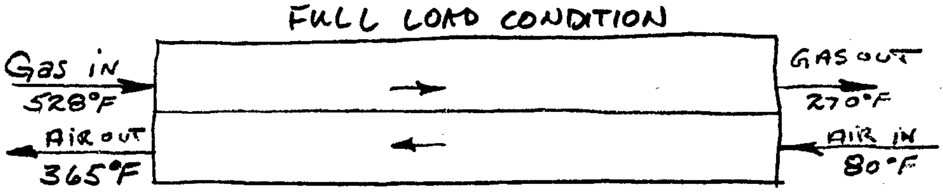
1,086 MBTU/HR (SEE ECO-BP7)

DETERMINE AIR OUTLET TEMPERATURE

$$Q_{AIR} = Q_{gas} = 1,086 \ \text{MBTU/HR} = 15852 \times 0.24 \times (T_{OUT} - 80)$$

$$T_{OUT} = 220°F$$

FULL LOAD CONDITION



ANNUAL GAS ENERGY SAVINGS

SINCE EXIT GAS TEMPERATURE IS EQUAL TO ECO-BP7 ENERGY SAVINGS ARE EQUAL = 3691 MBTU/yr

ANNUAL COST SAVINGS

SAME REASON AS ABOVE = $11,917 /YR

COMMENTS

1. SINCE SPECIFIC VOLUME OF AIR IS MANY TIMES LARGER THAN WATER, IT IS REASONABLE TO ASSUME THE SURFACE AREA WOULD BE MANY TIMES GREATER; RESULTING IN A HEAT EXCHANGER THAT IS LARGER, AND COSTS MUCH MORE, THAN THE AIR TO WATER H/X IN ECO-BP7.

2. THE INCREASE IN SPECIFIC VOLUME OF THE AIR WOULD CAUSE AN INCREASED ΔP ACCROSS ALL COMPONENTS UPSTREAM OF THE FURNACE, SO A NEW FD FAN WOULD BE REQUIRED

BP8-1

RS&H

SUBJECT FT. GORDON HOSPITAL
DESIGNER GWF
CHECKER
AEP NO
SHEET 2 OF 2
DATE 2-15-96
DATE

(3) AN INCREASE IN THE GAS PATH WOULD INCREASE THE PRESSURE DROP BETWEEN THE BOILER OUTLET AND THE STACK OUTLET. THIS ADDITIONAL ΔP WOULD HAVE TO BE PROVIDED THROUGH A LARGER FD FAN OR AN ID FAN.

(4) THE 365° AIR TEMPERATURE MIGHT CAUSE DIFFICULTIES WITH THE SCANER. OFTEN SCANNERS REQUIRE COOLING AIR (EXPENSIVE) TO OPERATE PROPERLY IN A "HOT" ENVIRONMENT.

(5) THIS ECO CAN NOT PAYBACK IN A REASONABLE TIME. THE AIR TO AIR HEAT EXCHANGER, LARGER FAN(S) AND UNCERTAIN OPERABILITY WILL COMBINE TO GENERATE A HIGH CAPITAL COST THAT COULD NEVER BE JUSTIFIED

RS&H	SUBJECT Ft. Gordon Hospital ECO-BP 3, 12 & 15	AEP NO	
	DESIGNER G.W.F.	SHEET 4 OF 5	
	CHECKER	DATE	
		DATE	

ECO-BP15

INSTALL O_2 TRIM CONTROLS.

O_2 TRIM CONTROLS SHOULD BE EVALUATED ASSUMING THE BOILER CONTROL SYSTEM IS IN GOOD WORKING ORDER AND IS PROPERLY SET AND TUNED. THE PURPOSE OF O_2 CONTROLS IS TO ADJUST FOR THE VARIABLES THAT CAN NOT BE CONSIDERED IN A MECHANICAL, OR AN ELECTRO-MECHANICAL SYSTEM. NAMELY, CHANGES IN AIR DENSITY AND CHANGES IN FUEL CONSTITUENCY, PRESSURE AND TEMPERATURE.

O_2 TRIM CONTROLS CAN NOT CORRECT THE ILLS OF A POORLY TUNED CONTROL SYSTEM.

ASSUME O_2 TRIM CONTROLS CAN SAVE 1.0 % OF THE '95 ENERGY CONSUMPTION (78,011 MBTU/yr)

ENERGY SAVED

E_s = 66,400 MBTU/yr × 0.01

= 640 MBTU/yr

Use based on TRACE run after renovation project

CONSTRUCTION COST ESTIMATE

Project:	Install O_2 Trim Controls	RS&H No.:	6941331005
Location:	Fort Gordon, GA	Date:	3/6/96
Basis:	Schematic Design	Estimator:	G.W.FALLON
Building:	EISENWOWER ARMY MEDICAL CENTER	Filename:	bp15.xls

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
								MMp	MMp
Stack O_2 probe	3	ea	500	1500	0	0	1,500	317	
Tune Air Flow Loop	3	ea		0	2938.25	8815	8,815		319
Subtotal Bare Costs				$ 1,500		$ 8,815	$ 10,315		
Retrofit Cost Factors			0%	$ -	0%	$ -	$ -	MEp6	MEp6
				-		-	-		
Subtotal				$ 1,500		$ 8,815	$ 10,315		
City Cost Index (Aug. GA)			0%	$ -	-46%	$ (4,055)	$ (4,055)	MMp533	MMp533
				-		-	-		
Subtotal				$ 1,500		$ 4,760	$ 6,260		
OH & Profit Markups			10%	$ 150	53%	$ 2,523	$ 2,673	MMp7	MMp7
				-		-	-		
Subtotal				$ 1,650		$ 7,283	$ 8,933		
Sales Taxes			6.0%	$ 99		NA	$ 99	MMp476	
				-		-	-		
Subtotal				$ 1,749		$ 7,283	$ 9,032		
Contingency			10%	$ 175	10%	$ 728	$ 903	MMp6	
				-		-	-		
Subtotal construction Cost				$ 1,924		$ 8,011	$ 9,935		
Design Fee				NA	6.0%	$ 542	$ 542		
SIOH				NA	6.0%	$ 542	$ 542		
				-		-	-		
Total Project Cost				$ 1,924		$ 9,095	$ 11,019		

LEGEND:

MMp### 1996 Means Mechanical Cost Data, page ###.

MEp### 1996 Means Electrical Cost Data, page ###.

BP15-2

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: BP15
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BP15 BOILER OXYGEN TRIM CONTROLS
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 03-13-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 9900.		
B. SIOH	$ 594.		
C. DESIGN COST	$ 594.		
D. TOTAL COST (1A+1B+1C)	$ 11088.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 11088.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	0.	$ 0.	13.68	$ 0.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	640.	$ 1728.	17.25	$ 29808.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		640.	$ 1728.		$ 29808.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 1728.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.42 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 29808.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.69
(IF < 1 PROJECT DOES NOT QUALIFY)

RS&H

SUBJECT Ft. Gordon Hospital
ECO BP-16
DESIGNER GWF.
CHECKER

AEP NO
SHEET 1 OF 1
DATE 3-1-96
DATE

ECO-BP-16 INSTALL PONY BOILER

AVERAGE ENERGY USE/MO. IN JUNE, JULY & AUGUST. = 4,309 MBTU/MO

CURRENT BOILER EFFICIENCY (PROPERLY OPERATING) = 78%

PONY BOILER EFFICIENCY = 82%

POTENTIAL GAS ENERGY SAVINGS

$S_{av} = (0.82 - 0.78) \times 4309 \ {}^{MBTU}/_{mo} \times 3 \ {}^{mo}/_{yr} = 517 \ MBTU/yr$

ANNUAL COST SAVINGS

517 MBTU/yr x \$2.70/MBTU = \$1396/yr.

BP16-1

CONSTRUCTION COST ESTIMATE

Project: Install Pony Boiler
Location: Fort Gordon, GA
Basis: Schematic Design
Building: N/A

RS&H No.:
Date: 2/27/96
Estimator: G.W.FALLON
Filename: bp16.xls

ITEM DESCRIPTION	QUANTITY No.	QUANTITY Unit	MATERIAL/EQUIP $/Unit	MATERIAL/EQUIP Total	LABOR $/Unit	LABOR Total	TOTAL COST	SOURCE Material MMp	SOURCE Labor MMp
boiler 60 psig, fire tube,									
10044 mBtu/hr	1	ea	61000	$61,000	15400	$15,400	$76,400	213	213
Piping--flanged, 150 lb WN									
w/yolk & hangers	50.0	ft	28.50	$1,425	29.10	$1,455	$2,880	141	141
Elbows 6" dia Steel WE	4	ea	43.00	$172	145.50	$582	$754	158	158
"T" 6" Dia WE	1	ea	59	$59	241.50	$242	$301	159	159
Flange 6" Dia WN	2	ea	38.50	$77	72.75	$146	$223	165	165
Valve 6" Dia Steam Shut-off	1	ea	1410.00	$1,410	246.40	$246	$1,656	191	191
250 lb Flanged									
Pipe 2"Dia TE	200	ft	4.49	$898	7	$1,350	$2,248	139	139
T 2" Dia TE	2	ea	9.80	$20	39.50	$79	$99	145	145
Elbow, 2" Dia TE	10	ea	6.95	$70	24.00	$240	$310	145	145
Flue Duct 16"dia	40	ft	166.00	$6,640	17.80	$712	$7,352	215	215
Subtotal Bare Costs				$71,771		$20,452	$92,223		
Contingency			10%	$7,177	10%	$2,045	$9,222	MEp6	MEp6
Subtotal				$78,948		$22,497			
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$71,771		$20,452	$92,223		
City Cost Index (Aug. GA)			0%	$0	-46%	($9,408)	($9,408)	MMp533	MMp533
				-		-	-		
Subtotal				$71,771		$11,044	$82,815		
OH & Profit Markups			10%	$7,177	53%	$5,853	$13,030	MMp7	MMp475
				-		-	-		
Subtotal				$78,948		$16,897	$95,845		
Sales Taxes			6.0%	$4,737		NA	$4,737	MMp476	
				-		-	-		
Subtotal				$83,685		$16,897	$100,582		
Design Fee				NA	6.0%	$6,035	$6,035		
SIOH				NA	6.0%	$6,035	$6,035		
				-		-	-		
Total Construction Cost				$83,685		$28,967	$112,652		

LEGEND:
MMp### 1996 Means Mechanical Cost Data, page ###.

BP16-2

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: BP16
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BP16 INSTALL PONY BOILER
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT
A. CONSTRUCTION COST $ 100600.
B. SIOH $ 6036.
C. DESIGN COST $ 6036.
D. TOTAL COST (1A+1B+1C) $ 112672.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 112672.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	0.	$ 0.	13.68	$ 0.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	517.	$ 1396.	17.25	$ 24079.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		517.	$ 1396.		$ 24079.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 1396.

5. SIMPLE PAYBACK PERIOD (1G/4) 80.72 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 24079.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .21
(IF < 1 PROJECT DOES NOT QUALIFY)

RS&H

SUBJECT Eisenhower AMC — ECO- BP17 - REPLACE BOILERS — AEP NO — SHEET 1 OF 1

DESIGNER GNF — DATE 2-20-96

CHECKER — DATE

ECO - BP17 REPLACE BOILERS with new unattended

NEW FIRETUBE BOILER ROUTINELY OPERATE UNATTENDED AT 80% EFFICIENCY. EXISTING BOILERS REQUIRE 4 OPERATORS @ a average EFFICIENCY OF 68.5%(1). ANNUAL '95 GAS CONSUMPTION WAS 78,011 MBTU/yr.

ANNUAL ENERGY SAVINGS

FY95 energy use = 78,011 Reduce by 20%

Reduce by 20% due to Renovation project (TRACE RUNS)

78,011 * 0.8 = 62,409 MBTU/yr

$$\text{N.Gas Savings} = 62{,}409 - \left(62{,}409 * \frac{0.685}{0.80}\right) = 8971 \ \frac{\text{MBTU}}{\text{yr.}}$$

ANNUAL LABOR COST SAVINGS

Current labor cost

4 people @ \$30,000	=	\$120,000
Maintenance	=	50,000
TOTAL		\$170,000

Proposed labor cost

$$1 \text{ person } 3\text{hr/da} = 3\frac{\text{hr}}{\text{da}} * 365\frac{\text{da}}{\text{yr}} \div 2080\frac{\text{hrs}}{\text{people-yr}} = 0.5 \text{ people}$$

0.5 people @ \$30,000	=	\$15,000
Maintenance		35,000
		\$50,000

LABOR SAVINGS = \$170,000 - \$50,000 = \$120,000/yr

CONSTRUCTION COST ESTIMATE

Project:	Install three, new, unattended boilers	RS&H No.:	6941331005
Location:	Fort Gordon, GA	Date:	3/6/96
Basis:	Schematic Design	Estimator:	G.W.FALLON
Building:	EISENWOWER ARMY MEDICAL CENTER	Filename:	BP17.xls

ITEM DESCRIPTION	QUANTITY No.	Unit	MATERIAL/EQUIP $/Unit	Total	LABOR $/Unit	Total	TOTAL COST	SOURCE Material	Labor
								MMp	MMp
boiler 60 psig, fire tube,									
16740 mBtu/hr	3	ea	81000	$243,000	23100	$69,300	$312,300	213	213
Piping--flanged, 150 lb WN									
w/yolk & hangers	150.0	ft	$ 28.5	$ 4,275	$ 29.1	$ 4,365	$ 8,640	141	141
Elbows 6" dia Steel WE	12	ea	$ 43.0	$ 516	$ 146	$ 1,746	$ 2,262	158	158
"T" 6" Dia WE	3	ea	$ 59.0	$ 177	$ 242	$ 725	$ 902	159	159
Flange 6" Dia WN	6	ea	$ 38.5	$ 231	$ 72.8	$ 437	$ 668	165	165
Valve 6" Dia Steam Shut-off	2	ea	1410	$ 2,820	$ 246	$ 493	$ 3,313	191	191
250 lb Flanged									
Pipe 2"Dia TE	600	ft	$ 4.49	$ 2,694	$ 6.8	$ 4,050	$ 6,744	139	139
T 2" Dia TE	6	ea	$ 9.80	$ 59	$ 39.5	$ 237	$ 296	145	145
Elbow, 2" Dia TE	30	ea	$ 6.95	$ 209	$ 24.0	$ 720	$ 929	145	145
Flue Duct 16"dia	120	ft	166	$ 19,920	$ 17.8	$ 2,136	$ 22,056	215	215
Subtotal Bare Costs				$ 273,901		$ 84,209	$ 358,110		
Retrofit Cost Factors			0%	$ -	0%	$ -	$ -	MEp6	MEp6
				-		-	-		
Subtotal				$ 273,901		$ 84,209	$ 358,110		
City Cost Index (Aug. GA)			0%	$ -	-46%	$ (38,736)	$ (38,736)	MMp533	MMp533
				-		-	-		
Subtotal				$ 273,901		$ 45,473	$ 319,374		
OH & Profit Markups			10%	$ 27,390	53%	$ 24,101	$ 51,491	MMp7	MMp7
				-		-	-		
Subtotal				$ 301,291		$ 69,574	$ 370,865		
Sales Taxes			6.0%	$ 18,077		NA	$ 18,077	MMp476	
				-		-	-		
Subtotal				$ 319,368		$ 69,574	$ 388,942		
Contingency			10%	$ 31,937	10%	$ 6,957	$ 38,894	MMp6	
				-		-	-		
Subtotal construction Cost				$ 351,305		$ 76,531	$ 427,836		
Design Fee				NA	6.0%	$ 23,337	$ 23,337		
SIOH				NA	6.0%	$ 23,337	$ 23,337		
				-		-	-		
Total Project Cost				$ 351,305		$ 123,205	$ 474,510		

LEGEND:
MMp### 1996 Means Mechanical Cost Data, page ###.

BP17-2

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: BP17
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-BP17 INSTALL UNATTENDED BOILERS
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 427800.	
B. SIOH	$ 25668.	
C. DESIGN COST	$ 25668.	
D. TOTAL COST (1A+1B+1C)	$ 479136.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 479136.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	0.	$ 0.	13.68	$ 0.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	8971.	$ 24222.	17.25	$ 417824.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		8971.	$ 24222.		$ 417824.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 120000.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1548000.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 1548000.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 144222.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.32 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 1965824.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 4.10
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.25 %

RS&H®

Telephone Call Confirmation

Project Number 694 1331 005

Local ______ L.D. ______ Placed ______ Rec'd ______ Date 3-7-96

Conversed with Ron Meshige Of York Intl. - Columbia, MD

Regarding New efficient chillers for Fort Gordon EAMC

I asked Ron if ~~the~~ they had a chiller with an efficiency better than the .638 kw/ton units spec'ed for Fort Gordon, and if so what would the incremental cost be.

Ron indicated that new chillers were not an option at this time because the chillers specified are already built. They are at the factory to be tested next week and shipped in about 2 weeks.

Distribution:

CP9-1

RS&H

SUBJECT ______ AEP NO ______
SHEET ______ OF ______
DESIGNER JJH DATE 6/12/96
CHECKER ______ DATE ______

ECO EL3 Power Factor Improvement

Calculate current power factor

Data:

	9/95	5/95
kw	4010	3884
kVAR	3147	2879

$$PF = \frac{kw}{kVA} \qquad kVA = \sqrt{kw^2 + kVAR^2}$$

$$= \frac{kw}{\sqrt{kw^2 + kVAR^2}}$$

For 9/95

$$PF = \frac{4010}{\sqrt{4010^2 + 3147^2}} = 0.79$$

For 5/95 $= \dfrac{3884}{\sqrt{3884^2 + 2879^2}} = 0.80$

RS&H

SUBJECT ______ AEP NO ______
SHEET ______ OF ______
DESIGNER ______ DATE ______
CHECKER ______ DATE ______

Geo. Pwr & L. charges \$0.27 / EXCESS kVAR.

EXCESS kVAR IS ANYTHING ABOVE 1/3 of DEMAND

CALCULATE REQ'D PF TO AVOID CHARGES:

$$PF = \frac{kW}{\sqrt{kW^2 + \left(\frac{kW}{3}\right)^2}} = \frac{kW}{\sqrt{kW^2 + \frac{kW^2}{9}}}$$

$$= \frac{kW}{\sqrt{\frac{10\,kW^2}{9}}} = \frac{\cancel{kW}}{\frac{\sqrt{10}}{3}\,\cancel{kW}}$$

$$= \frac{3}{\sqrt{10}} = \underline{\underline{0.95}}$$

Annual savings ≈

Excess kVAR averages 1500 / month

1500 kVAR * \$0.27 / kVAR * 12 mos = $\underline{\underline{\$4860}}$ / yr.

CONSTRUCTION COST ESTIMATE

Project:	ECO #EL3 Power Factor Improvement	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	7/9/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	EST_EL3.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Power Quality Analysis	1	ea	$0.00	$0	$2,300	$2,300	$2,300	(1)	(1)
1500 kVAR Capacitor,									
pad-mounted	1	ls	$0.00	$0	$67,500	$67,500	$67,500		
(1) Emde Power Services Co., see backup information									
This estimate includes overhead and profit									
Subtotal Bare Costs				$0		$69,800	$69,800		
Retrofit Cost Factors			0%	$0	0%	$0	$0		
				-		-	-		
Subtotal				$0		$69,800	$69,800		
City Cost Index (Aug. GA)			0%	$0	0%	$0	$0	MMp533	MMp533
				-		-	-		
Subtotal				$0		$69,800	$69,800		
OH & Profit Markups			10%	$0	0%	$0	$0	MMp7	MMp475
				-		-	-		
Subtotal				$0		$69,800	$69,800		
Sales Taxes			6.0%	$0		NA	$0	MMp476	
				-		-	-		
Subtotal				$0		$69,800	$69,800		
Contingency			10%	$0	10%	$6,980	$6,980	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$0		$76,780	$76,780		
Design Fee				NA	6.0%	$4,188	$4,188		
SIOH				NA	6.0%	$4,188	$4,188		
				-		-	-		
Total Project Cost				$0		$85,156	$85,156		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: E_EL3
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: EL3 POWER FACTOR CORRECTION
FISCAL YEAR 95 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 07-09-96 ECONOMIC LIFE 20 YEARS PREPARED BY: P. HUTCHINS

1. INVESTMENT
A. CONSTRUCTION COST $ 76800.
B. SIOH $ 4608.
C. DESIGN COST $ 4608.
D. TOTAL COST (1A+1B+1C) $ 86016.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 86016.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	0.	$ 0.	13.68	$ 0.
B. DIST	$ 5.41	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		0.	$ 0.		$ 0.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 4900.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 63210.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 63210.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 4900.

5. SIMPLE PAYBACK PERIOD (1G/4) 17.55 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 63210.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .73
(IF < 1 PROJECT DOES NOT QUALIFY)
**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

RS&H

SUBJECT ____________________
DESIGNER ____________________
CHECKER ____________________

AEP NO ____________
SHEET ______ OF ______
DATE ____________
DATE ____________

HOSPITAL DEMAND

	SUMMER PEAK (kW)	Winter Peak (kW)
CHILLERS (2)	1550	550
AHU's (13)	640	640
Lights	980	980
Misc Elec. Eq	810	810
Boiler Aux's	50	50
Small A/Cs	70	50
TOTAL	4100	3080

RS&H®

Telephone Call Confirmation

Project Number (713) 977-4141

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 7/1/96

Conversed with Tom Emde Of Emde Power Services Co. Houston

Regarding Power Factor Correction

If Pad-Mounted use $40 to $50 / KVAR

For 4200 KW at 0.8 PF → 0.95 need 1800 KVAR

If pole-mounted use $20 / KVAR

Could be as low as $14 / KVAR if there are no harmonics problems

Probably doesn't need to be remotely switched, since load is so constant

Should have power quality analysis before doing anything

Costs would be $1500 + expenses (2-days total)

Distribution:

EL3-6

RS&H	SUBJECT	AEP NO	
		SHEET	OF
	DESIGNER Hutchins	DATE 7/8/96	
	CHECKER	DATE	

ECO EL4. Use Emergency Generator to Reduce Demand

The EAMC can add the Interuptible Service (IS) Rider and receive annual credit of \$45/kW. The minimum is 200 kW and the maximum is 95% of their billing demand - this is 95% of 2960 kW = 2812 kW.

Calculate amount for IS Rider.

Current all time peak	=	4200 kW
Billing demand (SE Rider)	=	2960
Current needs	=	1240 kW

Under the existing Supplemental Energy rider the EAMC needs at least 1240 kW to meet the contract requirement at peak load.

With full paralleling of 2100 kW the EAMC will have a generating capacity = 2100 + 800 = 2900 kW

Excess for IS = 2900 - 1240 = 1660 kW

Contracting for 90% of this yields

90% of 1660 kW ≈ 1500 kW

Savings = 1500 kW * \$45/kW = \$67,500/yr.

RS&H

SUBJECT ______ AEP NO ______

SHEET ______ OF ______

DESIGNER ______ DATE ______

CHECKER ______ DATE ______

Calculate additional maintenance and fuel costs -

Fuel costs -

Performance is 15 kw / gal fuel oil

$$\frac{1500\ kw}{15\ kw/gal} = \underline{\underline{100\ gal/hr}}$$

Assume it runs 30 hrs/yr.

$$\text{Fuel cost} = 100\ \frac{gal}{hr} * \frac{30\ hr}{yr} * \frac{\$0.75}{gal} = \underline{\underline{\$2250/yr}}$$

Maintenance ≈ fuel costs ≈ $\$2\underline{\underline{300}}/yr$

Electricity savings = 1500 kw * 30 hrs = 4500 kwh
= $\underline{\underline{15.4}}$ MBtu

Demand savings = $0.80/kw * $1500/kw/mon * 4 mos/yr
= $\$4\underline{\underline{800}}$

Fuel use = 100 * 30 = $\underline{3000}$ gal
= $\underline{\underline{416.1}}$ MBtu (138,700 Btu/gal)

Convert fuel oil costs to MBtu

$$\frac{\$0.75}{gal} * \frac{gal}{138{,}700\ Btu} * \frac{1E6\ Btu}{MBtu} = \underline{\$5.41}/MBtu$$

CONSTRUCTION COST ESTIMATE

Project:	ECO #EL4 Use Emergency Generator to Reduce Demand	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	7/8/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	EST_EL4.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Paralleling switchgear	1	ea	$85,000.00	$85,000	$48,500	$48,500	$133,500	(1)	(1)
2100 KW hardware & softw	1	ls	$5,000.00	$5,000	$2,900	$2,900	$7,900		
Protective relaying	1	ls	$5,500.00	$5,500	$3,100	$3,100	$8,600		
(1) Stewart & Stephenson, see backup information.									
This estimate includes overhead and profit									
Subtotal Bare Costs				$95,500		$54,500	$150,000		
Retrofit Cost Factors			0%	$0	0%	$0	$0		
				-		-	-		
Subtotal				$95,500		$54,500	$150,000		
City Cost Index (Aug. GA)			0%	$0	0%	$0	$0	MMp533	MMp533
				-		-	-		
Subtotal				$95,500		$54,500	$150,000		
OH & Profit Markups			10%	$9,550	0%	$0	$9,550	MMp7	MMp475
				-		-	-		
Subtotal				$105,050		$54,500	$159,550		
Sales Taxes			6.0%	$6,303		NA	$6,303	MMp476	
				-		-	-		
Subtotal				$111,353		$54,500	$165,853		
Contingency			10%	$11,135	10%	$5,450	$16,585	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$122,488		$59,950	$182,438		
Design Fee				NA	6.0%	$9,951	$9,951		
SIOH				NA	6.0%	$9,951	$9,951		
				-		-	-		
Total Project Cost				$122,488		$79,852	$202,340		

LEGEND:

MMp### 1996 Means Mechanical Cost Data, page ###.
MEp### 1996 Means Electrical Cost Data, page ###.
Gp### 1995 Grainger, page ###
Dp### 2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: E_EL4
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO EL4 USE EMERGENCY GENERATOR TO REDUCE DEMAND
FISCAL YEAR 95 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 07-08-96 ECONOMIC LIFE 20 YEARS PREPARED BY: P. HUTCHINS

1. INVESTMENT

A. CONSTRUCTION COST	$ 182400.		
B. SIOH	$ 10944.		
C. DESIGN COST	$ 10944.		
D. TOTAL COST (1A+1B+1C)	$ 204288.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 204288.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	15.	$ 117.	13.68	$ 1605.
B. DIST	$ 5.41	-416.	$ -2251.	14.64	$ -32948.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 4800.	15.38	$ 73824.
N. TOTAL		-401.	$ 2667.		$ 42481.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 65200.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 841080.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 841080.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 67867.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.01 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 883561.

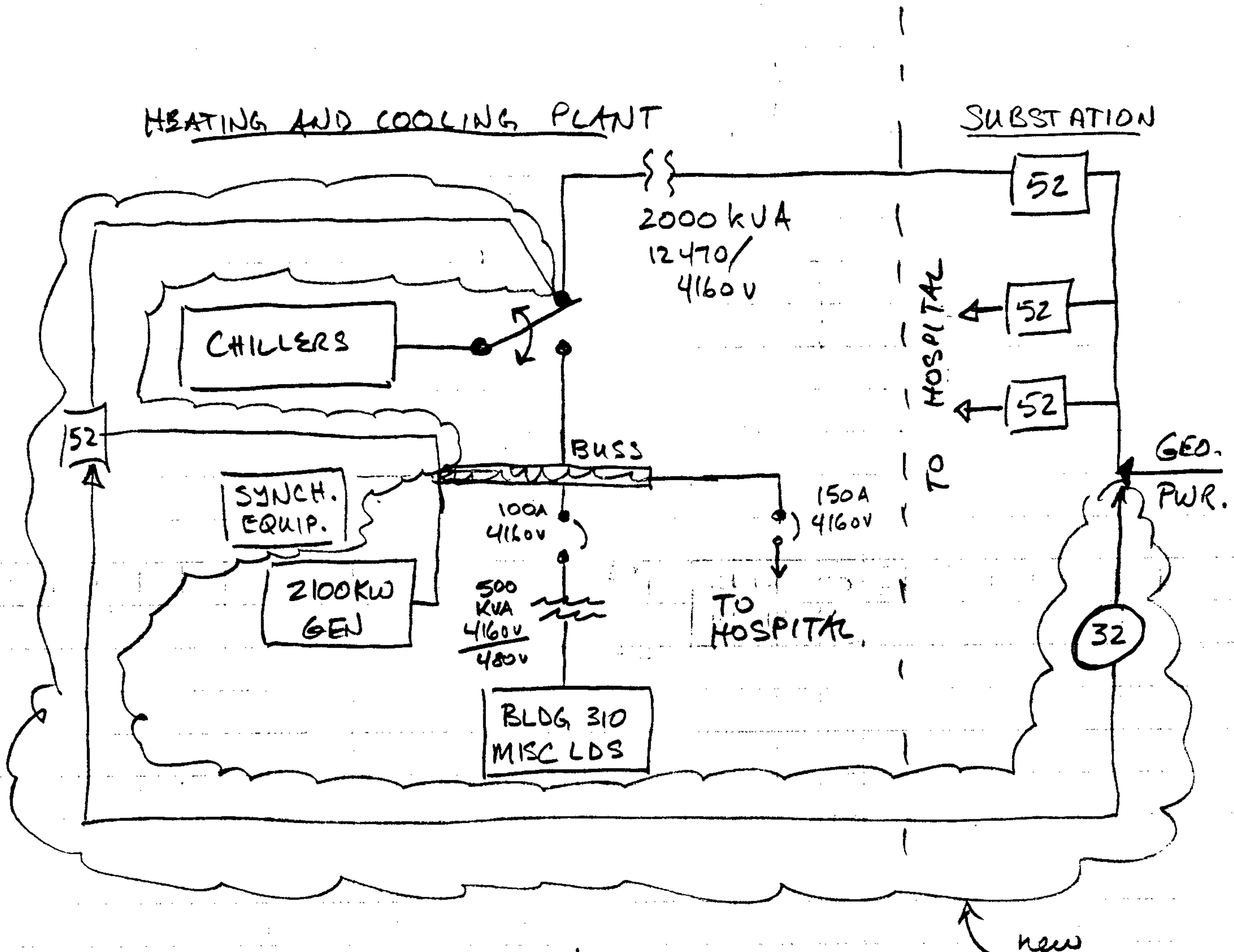
7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 4.33
(IF < 1 PROJECT DOES NOT QUALIFY)
**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

EL4-4

RS&H

SUBJECT FT GORDON HOSPITAL
DESIGNER PAUL HUTCHINS
CHECKER
AEP NO
SHEET OF
DATE 6/26/96
DATE



GEN. 140 gal/hr at max ld.
(15 KW/gal fuel)

Maint. cost is about the same as fuel cost

DISTANCE BETWEEN SUBSTATION AND GENERATOR IS ~100 yds.

(52) Air Breaker
(32) Reverse current sensing relay

POWER SPECIALISTS

FAX COVER

Title : MR. First Name : PAUL Last Name : HUTCHINS

Company : REYNOLDS, SMITH AND HILLS, INC.

Subject : FT. GORDON

From : DAVID CURRY

Company : STEWART & STEVENSON, INC.

Fax Number : 713-671-6118 Voice : 713-671-6111

Pages : 1 Date : 7/3/96

Time : 12:16:40

NOTES:

PARALLELING SWITCHGEAR	$85,000.00
2100 KW HARDWARE & SOFTWARE	$5,000.00
PROTECTIVE RELAYING	$5,500.00
ELECTRICAL CONTRACTOR	$14,500.00
LABOR	$40,000.00

EL4-6

RS&H

Telephone Call Confirmation

Project Number ______________

(713) 671-6111
-6118 (fax)

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 6/26/96

Conversed with David Curry of Stewart & Stevenson Houston, TX

Regarding Synchronizing 2100 kw Gen. & Power Factor Correction

Other names - Richard Harris & Rodney Taylor
(713) 671-6100

DC said he could get budget estimates on both subjects in a short time.

PH faxed schematic diagram of site drawn by Bob Calhoun

Distribution:

EL4-7

RS&H

Telephone Call Confirmation

Project Number ____________

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 6/17/96

Conversed with Michael Richardson of Georgia Power & Light

Regarding Interruptible Service Rider (IS)

The IS Rider calls for the user to reduce its demand by the contracted amount. Currently, the credit is $45/kW and is paid once a year. ~~On an annual~~

The minimum is 200kW. IS curtailments are called after SE.

Cannot use IS and Day Ahead RTP rates (This is the RTP rate the hospital would use since the other RTP rate, Hour Ahead, requires a minimum demand of 5000KW. Day Ahead requires 1000 KW minimum.

The IS requires a 3-year contract that "rolls over" each year. In other words you must stay on it for three years after notification to leave.

The hospital could contract up to 95% of their Billing Demand (2960KW) or 2812KW

Distribution:

EL4-8

RS&H

SUBJECT Ft. Gordon ECO Analysis	AEP NO
	SHEET 1 OF 1
DESIGNER T. Todd	DATE 3-1-96
CHECKER	DATE

ECO #EL6 Convert to energy-efficient motors.

Field survey notes were reviewed to determine which electric motors were candidates for analysis which were not scheduled to be changed out as part of the Renovation Project.

The table on p. EL6-2 contains the calculation and/or estimates of motor hp for exhaust fans whose nameplate data was not obtained during field surveys.

A preliminary screening analysis of all motors from 1 hp to 200 hp is shown on p. EL6-3. Since all motors from 5hp to 60 hp have a simple payback less than 10 years, these sizes were selected for detailed analysis.

Detailed energy and cost savings for specific motors were calculated on p. EL6-4 under current operation conditions and on p. EL-5 under projected operating conditions after the Renovation Project has been completed. Motor ID#'s refer to the following types:

ID#	Type
EF	~~Attic~~ exhaust fan
HW Supply	Hot water supply pump
MUA	Make up air fan
RA	AHU Return air fan
SF	AHU Supply fan

Energy Efficient Motors
Filename: EEMEF.XLS
Fort Gordon
Augusta, GA

EXHAUST FAN NO	CFM	STATIC PRESS (IN)	CALC BHP	CALC MOTOR HP	MOTOR HP (EST)	MEAS'D KW	CALC HP FROM KW	MOTOR HP (EST)	FIELD DATA MOTOR HP	HP USED FOR EVAL
1	16600	0.75	3.26	5	5				5	5
2	22000	0.75	4.33	6	7.5				7.5	7.5
3	3700	1.75	1.70	3	3				2	3
4	16900	1.25	5.54	8	10				15	15
5	14400	0.75	2.83	4	5					5
6	27900	0.75	5.49	8	10					10
7	35600	2.75	25.67	35	40				100	100
8	6500	0.5	0.85	2	2				5	5
9	26000	0.5	3.41	5	5					5
10	1490	2	0.78	2	2					2
11	11950	-	-	-	-					
12	17300	0.75	3.40	5	5					5
13	15265	0.75	3.00	5	5	3.70	7.00	7.50		7.5
14	14700	0.75	2.89	4	5	0.75	2.00	2.00		5
15	12000	0.75	2.36	4	5	2.55	5.00	5.00		5
16	16610	0.75	3.27	5	5	4.00	8.00	10.00		10
17	325	2.5	0.21	1	1					1

Energy Efficient Motor Preliminary Analysis
Filename: EEM3.XLS
Site: Fort Gordon
Augusta, GA

19-Jun-96

Application : Various Motors
Percent Motor Load: 75 %
Operating Hours : 8760 Hrs/Yr
Electric Rate
Energy : $0.026 /kWh
Demand : /kW

Labor Cost: $27.50 /hr

MOTOR HP	EXIST EFF (1)	ENERGY EFF (2)	EXIST KW	ENEFF KW	KW SAVE	KWH/YR SAVED	$/YR SAVED	MATL COST (3)	LABOR COST (4)	TOTAL COST (5)	SIMPLE PAYBACK	LABOR (HRS)
1.0	72.0%	84.0%	0.78	0.67	0.11	976	25	188	49	280	11.0	1.78
1.5	77.0%	84.0%	1.09	1.00	0.09	799	21	173	49	264	12.7	1.78
2.0	80.0%	84.0%	1.40	1.34	0.07	586	15	221	49	317	20.8	1.78
3.0	84.0%	90.2%	2.01	1.87	0.14	1,207	31	221	49	317	10.1	1.78
5.0	84.0%	89.5%	3.34	3.14	0.21	1,799	47	302	49	406	8.7	1.78
7.5	85.5%	91.7%	4.93	4.59	0.33	2,917	76	377	53	493	6.5	1.91
10.0	86.5%	91.7%	6.49	6.12	0.37	3,225	84	455	55	583	7.0	2.00
15.0	87.5%	93.0%	9.63	9.06	0.57	4,987	130	605	69	769	5.9	2.50
20.0	88.5%	93.6%	12.69	12.00	0.69	6,057	157	739	85	940	6.0	3.08
25.0	89.5%	94.1%	15.68	14.92	0.77	6,717	175	858	88	1,076	6.2	3.20
30.0	89.5%	94.1%	18.82	17.90	0.92	8,060	210	997	92	1,234	5.9	3.33
40.0	91.0%	95.0%	24.68	23.64	1.04	9,104	237	1,401	110	1,706	7.2	4.00
50.0	91.0%	95.0%	30.85	29.55	1.30	11,379	296	1,590	138	1,955	6.6	5.00
60.0	91.7%	95.4%	36.74	35.31	1.42	12,482	325	2,108	157	2,554	7.9	5.71
75.0	93.0%	95.4%	45.28	44.14	1.14	9,979	259	2,373	183	2,885	11.1	6.67
100.0	93.0%	95.4%	60.38	58.86	1.52	13,306	346	3,120	244	3,799	11.0	8.89
125.0	93.0%	95.4%	75.47	73.57	1.90	16,632	432	3,624	314	4,458	10.3	11.43
150.0	94.1%	96.2%	89.51	87.55	1.95	17,116	445	4,829	367	5,862	13.2	13.33
200.0	94.5%	95.8%	118.84	117.22	1.61	14,126	367	6,356	440	7,652	20.8	16.00

(1) NEMA nominal efficiency of a new standard efficient 1800 rpm ODP motor (460V, 3 phase).
(2) NEMA nominal efficiency of a new "GE Brand Premium Efficiency" 1800 RPM ODP motor.
(3) Grainger 1995 prices for GE Premium Efficiency, 1800 RPM, ODP motors
(4) Means 1995 Electrical Cost Data adjusted for Augusta, GA plus 53% mark-up.

EL6-3

EXISTING MOTORS- CURRENT OPERATING HOURS

MOTOR ID #	HP	NO	% LOAD	% EFF	KW	HRS/ YR	KWH/YR	ENERGY COST	DEMAND COST
EF-2,13	7.5	2	75%	85.5%	10	8,760	85,986	$2,236	$0
EF-6,16	10	2	75%	86.5%	13	8,760	113,323	$2,946	$0
EF-4	15	1	75%	87.5%	10	8,760	84,021	$2,185	$0
SF-5	20	1	100%	88.5%	17	8,760	147,683	$3,840	$0
MUA	20	1	75%	88.5%	13	8,760	110,762	$2,880	$0
HW SUPPLY	25	3	75%	89.5%	47	5,840	273,811	$7,119	$0
RA-1A,1B,2A,2B	30	4	75%	89.5%	75	8,760	657,147	$17,086	$0
SF-6	40	1	100%	91.0%	33	8,760	287,251	$7,469	$0
		15			217		1,759,984	$45,760	$0

TOTAL ELECTRIC COST $45,760

HIGH EFFICIENCY MOTORS- CURRENT OPERATING HOURS

MOTOR ID #	HP	NO	% LOAD	% EFF	KW	HRS/ YR	KWH/YR	ENERGY COST	DEMAND COST
EF-2,13	7.5	2	75%	91.7%	9	8,760	80,173	$2,084	$0
EF-6,16	10	2	75%	91.7%	12	8,760	106,897	$2,779	$0
EF-4	15	1	75%	93.0%	9	8,760	79,052	$2,055	$0
SF-5	20	1	100%	93.6%	16	8,760	139,636	$3,631	$0
MUA	20	1	75%	93.6%	12	8,760	104,727	$2,723	$0
HW SUPPLY	25	3	75%	94.1%	45	5,840	260,426	$6,771	$0
RA-1A,1B,2A,2B	30	4	75%	94.1%	71	8,760	625,023	$16,251	$0
SF-6	40	1	100%	95.0%	31	8,760	275,156	$7,154	$0
		15			206		1,671,089	$43,448	$0

TOTAL ELECTRIC COST $43,448
ANNUAL KWH SAVINGS 88,895
ANNUAL COST SAVINGS $2,311

SAVINGS

$$\frac{88{,}895 \text{ kwh} \times 3413}{1E6} = \underline{303 \text{ MBtu}}$$

ELG-4

EXISTING MOTORS- PROJECTED OPERATING HOURS

MOTOR ID #	HP	NO	% LOAD	% EFF	KW	HRS/ YR	KWH/YR	ENERGY COST	DEMAND COST
EF-2,13	7.5	2	75%	85.5%	10	8,760	85,986	$2,236	$0
EF-6	10	1	75%	86.5%	6	8,760	56,662	$1,473	$0
EF-16	10	1	75%	86.5%	6	5,096	32,962	$857	$0
EF-4	15	1	75%	87.5%	10	8,760	84,021	$2,185	$0
SF-5	20	1	75%	88.5%	13	8,760	110,762	$2,880	$0
MUA	20	1	75%	88.5%	13	5,460	69,037	$1,795	$0
HW SUPPLY	25	3	75%	89.5%	47	5,840	273,811	$7,119	$0
RA-1A,1B,2A,2B	30	4	75%	89.5%	75	8,760	657,147	$17,086	$0
SF-6	40	1	100%	91.0%	33	8,760	287,251	$7,469	$0
		15			212		1,657,638	$43,099	$0

TOTAL ELECTRIC COST $43,099

HIGH EFFICIENCY MOTORS- PROJECTED OPERATING HOURS

MOTOR ID #	HP	NO	% LOAD	% EFF	KW	HRS/ YR	KWH/YR	ENERGY COST	DEMAND COST
EF-2,13	7.5	2	75%	91.7%	9	8,760	80,173	$2,084	$0
EF-6	10	1	75%	91.7%	6	8,760	53,448	$1,390	$0
EF-16	10	1	75%	91.7%	6	5,096	31,093	$808	$0
EF-4	15	1	75%	93.0%	9	8,760	79,052	$2,055	$0
SF-5	20	1	75%	93.6%	12	8,760	104,727	$2,723	$0
MUA	20	1	75%	93.6%	12	5,460	65,275	$1,697	$0
HW SUPPLY	25	3	75%	94.1%	45	5,840	260,426	$6,771	$0
RA-1A,1B,2A,2B	30	4	75%	94.1%	71	8,760	625,023	$16,251	$0
SF-6	40	1	100%	95.0%	31	8,760	275,156	$7,154	$0
		15			202		1,574,373	$40,934	$0

TOTAL ELECTRIC COST $40,934
ANNUAL KWH SAVINGS 83,266
ANNUAL COST SAVINGS $2,165

MBTU SAVINGS =

$$\frac{83{,}266 \text{ kwh} \times 3413}{1E6}$$

$= \underline{284}$ MBtu/yr.

CONSTRUCTION COST ESTIMATE

Project:	Energy Efficient Motors	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	06/19/96
Basis:	Schematic Design	Estimator:	T. Todd
Building:	Hospital	Filename:	EST2-EL6.xls

	QUANTITY		MATERIAL/EQUIP		LABOR (1)		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Hi-eff 1800 RPM, 7.5 hp	2	ea	377	754	112	224	978	Gp26,27	MEp199
Hi-eff 1800 RPM, 10 hp	2	ea	455	910	117	234	1,144	Gp26,27	MEp199
Hi-eff 1800 RPM, 15 hp	1	ea	605	605	147	147	752	Gp26,27	MEp199
Hi-eff 1800 RPM, 20 hp	2	ea	739	1,478	180	361	1,839	Gp26,27	MEp199
Hi-eff 1800 RPM, 25 hp	3	ea	858	2,574	188	563	3,137	Gp26,27	MEp199
Hi-eff 1800 RPM, 30 hp	4	ea	997	3,988	195	781	4,769	Gp26,27	MEp199
Hi-eff 1800 RPM, 40 hp	1	ea	1,401	1,401	234	234	1,635	Gp26,27	MEp199
Subtotal Bare Costs				11,710		2,544	14,254		
Retrofit Cost Factors			0%	0	0%	0	0	MMp6	MMp6
Subtotal				11,710		2,544	14,254		
City Cost Index (Aug. GA)			0%	0	-46%	(1,170)	(1,170)	MMp533	MMp533
Subtotal				11,710		1,374	13,084		
OH & Profit Markups			10%	1,171	53%	728	1,899	MMp7	MMp475
Subtotal				12,881		2,102	14,983		
Sales Taxes			6.0%	773		NA	773	MMp476	
Subtotal				13,654		2,102	15,756		
Contingency			10%	1,171	10%	254	1,425	MEp6	MEp6
Construction Cost				14,825		2,356	17,181		
Design Fee				NA	6.0%	1,031	1,031		
SIOH				NA	6.0%	1,031	1,031		
Total Project Cost				14,825		4,418	19,243		

(1) Labor cost includes removal of old motors and installation of new motors, and is equal to twice the Means cost for installation.

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###.

EL6-6

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: EL6
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-EL6 ENERGY EFFICIENT MOTORS
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT
A. CONSTRUCTION COST $ 17200.
B. SIOH $ 1032.
C. DESIGN COST $ 1032.
D. TOTAL COST (1A+1B+1C) $ 19264.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 19264.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	284.	$ 2164.	13.68	$ 29605.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		284.	$ 2164.		$ 29605.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 2164.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.90 YEARS

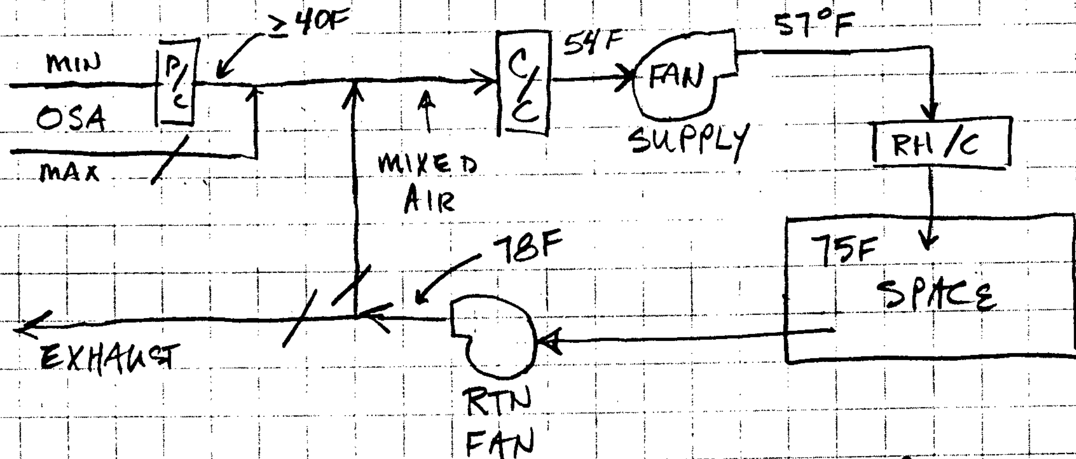
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 29605.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.54
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.87 %

ECO - HS3 EXHAUST AIR ENERGY RECOVERY

AHU-4E and AHU-4W are located on the 14 th floor and serve the 4th through the 13th floors. These AHU's have outside air economizer controls that are going to be repaired/replaced with the FY96 Renovation Project. Below is a sketch of the airflows



The economizer produces savings any time the OSA ≤ RTN air temp.

Calculate minimum OSA for economizer operation using measured supply air rates and minimum OSA requirements:[1]

Return CFm × RAT + OA CFm × OAT = Supply CFm × SAT

AHU-4E: 82,900 × 78 + 24,100 × OAT = 107,000 × 54°F

$$\text{AHU-4E: } OAT = \frac{107{,}000 \times 54 - 82{,}900 \times 78}{24{,}100} = -5\,°F$$

$$\text{AHU-4W: } OAT = \frac{102{,}000 \times 54 - 77{,}900 \times 78}{24{,}100} = -1\,°F$$

(1) this assumes OSA will be reduced to minimums as part of FY96 Renovation Project

SUBJECT ______
DESIGNER ______
CHECKER ______

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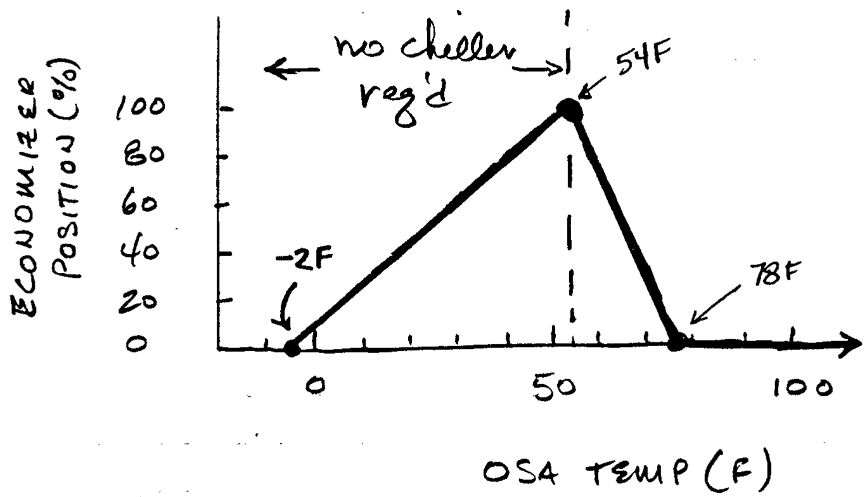
DATE ______
DATE ______

THE TABLE BELOW summarizes economizer use vs OSA T.



Heating is only used for preheat of minimum OSA and space reheats. Therefore, there can be no heating energy savings

ECO - HS3 (continued)

The cooling energy savings were calculated using bin temperature data and a spreadsheet computer program.

Cooling energy savings: (from spreadsheets)

AHU-4E = 197.8 MBtu/YR

AHU-4W = 197.8 MBtu/YR

Total = 395.6 MBtu/YR

$$\text{Chiller COP} \approx 1 \Big/ \left(0.7 \frac{kw}{ton} \times \frac{3413 \text{ Btu/hr}}{kw} \times \frac{1 \text{ ton}}{12000 \text{ Btu/hr}}\right) \approx 5$$

$$\text{Elec. Savings} = 395.6 \frac{MBtu}{YR} \div 5 = \underline{\underline{79}} \ MBtu/YR$$

$$\text{Cost Savings} = 79 \frac{MBtu}{YR} \times \$7.62/MBtu = \underline{\$602/YR}$$

Fan energy increase: assume coils add ~1" SP to supply & exh. fans

$$\text{additional BHP} = \frac{cfm \times SP}{6356 \times \text{fan eff}} = \frac{24{,}100 \times 2 \times 1''}{6356 \times 0.6} = 12.6 \text{ BHP}$$

supply fans : 12.6 BHP × 0.746 $\frac{kw}{BHP}$ ÷ 0.93 = 10.1 kw $\eta_{125hp \ motor} = 0.93$

exh. fans : 17.8 BHP × 0.746 ÷ 0.91 = 14.6 kw $\eta_{40hp \ motor} = 0.91$
(this would require new exhaust fan too)

(10.1 kw + 14.6 kw) × 8760 hr/YR = 216,372 $\frac{kwh}{YR}$ ⇒ $\underline{\$5626/YR \text{ increase}}$

RS&H

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DATE

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Since it would cost more in fan energy due to increased pressure drop across heat recovery coils, than the savings produced - the project warrants no further analysis.

Assumptions:

Typical centrifugal fan eff. 0.6 [1]

Motor efficiencies

125 hp motor - 0.93 [2]
40 hp motor - 0.91 [2]

(1) Industrial Ventilation, 15th edition p. 10-9

(2) Grainger 1995 Catalogue p. 27

Exhaust Air Energy Recovery System 06/29/96

Filename: ECO-HS3.WB2

Project: ECO-HS3 - Exhaust Energy Recovery

Location: Fort Gordon, GA

Calculation Data:

Outside air flow (OAcfm):	24,100	cfm
Exhaust air flow (EAcfm):	24,100	cfm
Heat recovery factor (R):	0.60	
Exhaust air temperature (Te):	78	°F
Operating hours from 12M to 8am:	8	Hours
Operating hours from 8am to 4pm:	8	Hours
Operating hours from 4pm to 12M:	8	Hours
Minimum OAT for cooling recovery:	78	°F

OAT		Average	Hours per Year			Total	Operating	Tsl	Energy Recovered	
Range (°F)		OAT (°F)	0-8	8-16	16-24	Hr/Yr	Hr/Yr	(°F)	Btu/Hr	MBtu/Yr
105	109	107	0	0	0	0	0	89.6	(452,887)	0.0
100	104	102	0	6	0	6	6	87.6	(374,803)	(2.2)
95	99	97	0	62	12	74	74	85.6	(296,719)	(22.0)
90	94	92	0	228	65	293	293	83.6	(218,635)	(64.1)
85	89	87	4	359	133	496	496	81.6	(140,551)	(69.7)
80	84	82	33	372	232	637	637	79.6	(62,467)	(39.8)
75	79	77	203	323	377	903	903	77.6	0	0.0
70	74	72	494	273	386	1153	1153	75.6	0	0.0
65	69	67	363	267	302	932	932	73.6	0	0.0
60	64	62	300	241	277	818	818	71.6	0	0.0
55	59	57	265	221	254	740	740	69.6	0	0.0
50	54	52	248	198	241	687	687	67.6	0	0.0
45	49	47	246	149	217	612	612	65.6	0	0.0
40	44	42	235	112	181	528	528	63.6	0	0.0
35	39	37	205	64	127	396	396	61.6	0	0.0
30	34	32	160	29	73	262	262	59.6	0	0.0
25	29	27	105	10	29	144	144	57.6	0	0.0
20	24	22	45	3	9	57	57	55.6	0	0.0
15	19	17	14	0	1	15	15	53.6	0	0.0
10	14	12	2	0	0	2	2	51.6	0	0.0
5	9	7	0	0	0	0	0	49.6	0	0.0
Totals			2922	2917	2916	8755	8755		Cooling =	(197.8)
									Heating =	0.0

Equations:

M = Mass flow ratio = larger cfm / smaller cfm = 1.00

Rs = Heat recovery factor = R = 0.60

Tsl = Outside air temp leaving ht rec coil = Tse + (Rs x (Te - Tse))

Tse = Average outside air temp. (entering coil temp)

Energy recovered, Btu/Hr = 1.08 x Scfm x (Tsl - Tse)

Energy recovered, MBtu/Yr = Btu/Hr x Oper Hr/Yr / 1000000

AUGUSTA/BUSH FIELD GEORGIA

Temperature Range	NOVEMBER Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B	DECEMBER Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B	JANUARY Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B
105/109															
100/104															
95/99															
90/94		0		0	71										
85/89		2	0	2	70										
80/84		6	1	7	67		0		0	69		0		0	67
75/79		19	2	21	64		5	0	5	66		3	1	4	65
70/74	1	33	11	45	62		12	2	14	62	0	11	3	14	62
65/69	11	41	25	77	60	4	21	9	34	60	4	21	10	35	60
60/64	22	38	33	93	56	11	31	19	61	56	9	25	20	54	56
55/59	22	36	34	92	52	17	34	28	79	52	17	35	22	74	51
50/54	27	35	39	101	47	20	41	36	97	47	22	39	31	92	47
45/49	43	20	36	99	44	31	39	38	108	43	25	35	43	103	43
40/44	35	7	28	70	39	38	32	41	111	38	35	35	44	114	38
35/39	33	3	19	55	35	36	19	38	93	34	40	26	35	101	34
30/34	28	1	9	38	31	39	9	22	70	30	40	11	23	74	30
25/29	14	0	2	16	26	30	3	10	43	26	31	5	12	48	25
20/24	3		0	3	22	16	1	4	21	21	18	1	4	23	21
15/19	0			0	18	6	0	1	7	17	6	0	0	6	17
10/14						1	0		1	12	0			0	12
5/9						0			0	7					

Temperature Range	FEBRUARY Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B	MARCH Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B	APRIL Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B
105/109															
100/104															
95/99															
90/94												1	0	1	73
85/89							1	0	1	68		14	3	17	68
80/84		1	0	1	67		8	3	11	66		34	13	47	66
75/79		9	2	11	64		17	7	24	63	1	43	22	66	64
70/74	0	16	7	23	61	3	28	16	47	60	7	44	36	87	62
65/69	5	24	14	43	58	10	37	26	73	58	27	42	51	120	60
60/64	10	30	25	65	55	20	41	40	101	55	53	32	44	129	57
55/59	23	33	31	87	51	32	41	44	117	51	50	21	32	103	53
50/54	25	36	38	99	47	37	31	40	108	47	38	8	21	67	48
45/49	34	30	37	101	43	42	22	32	96	43	27	2	12	41	44
40/44	35	24	31	90	39	42	13	23	78	39	24	0	5	29	40
35/39	34	12	21	67	34	37	4	10	51	34	11		1	12	36
30/34	27	5	12	44	30	18	3	6	27	30	2			2	32
25/29	22	2	4	28	25	7	0	1	8	26					
20/24	7	1	1	9	20	1			1	21					
15/19	2	0	0	2	16										
10/14	1	0		1	11										
5/9															

Temperature Range	ANNUAL TOTAL Obsn Hour Gp 01 to 08	09 to 16	17 to 24	Total Obsn	M C W B
105/109		0	0	0	74
100/104		6	0	6	77
95/99		62	12	74	76
90/94	0	228	65	293	75
85/89	4	359	133	496	74
80/84	33	372	232	637	72
75/79	203	323	377	903	70
70/74	494	273	386	1153	67
65/69	363	267	302	932	62
60/64	300	241	277	818	57
55/59	265	221	254	740	52
50/54	248	198	241	687	48
45/49	246	149	217	612	43
40/44	235	112	181	528	39
35/39	205	64	127	396	34
30/34	160	29	73	262	30
25/29	105	10	29	144	26
20/24	45	3	9	57	21
15/19	14	0	1	15	17
10/14	2	0		2	12
5/9	0			0	7

HS3-6

RS&H

SUBJECT ECO-HS7
Ft. Gordon EAMC
DESIGNER B. Todd
CHECKER T. Todd

AEP NO 694-1331-005
SHEET ____ OF ____
DATE 3-4-96
DATE ____

ECO-HS7 Install Variable Air Volume Controls

AHU-4E and AHU-4W serve the 4th through 11th floors of the hospital. the fourth floor is administrative offices which are only occupied during regular business hours. For this project, it is assumed that the 4th floor air will be turned off from 6pm to 6 am, and that the air flow will modulate between 50% and 100% from 6 am to 6 pm using variable air volume (VAV) controls.

the following fan motors would have variable frequency drives installed:

AHU	FAN TYPE	FAN #	MOTOR HP
4W	SUPPLY	SF-4A	125
	RETURN	RA-2A	30
4E	SUPPLY	SF-4B	125
	RETURN	RA-2B	30

Air flows for the 4 zones of the 4th floor are shown on p. HS7-3. From these calculations, it is estimated that the 4th floor uses ~20% of total supply CFM and ~20% of total return CFM of AHU's 4E & 4W.

Energy savings for the 125 hp and 30 hp fan motors are calculated on p. HS7-4 and HS7-5. the projected reductions in air flow as described above are indicated in the spreadsheet by 6 hrs/day at 90% and 12 hrs/day at 80% flow. Efficiencies are from Grainger for standard efficiency General Electric, 3 phase ODP motors.

RS&H

SUBJECT ECO-HS7
Ft. Gordon
DESIGNER B. Todd
CHECKER T. Todd

AEP NO 694-1331-005
SHEET ____ OF ____
DATE 3-4-96
DATE ____

A schematic diagram showing the proposed installation of VAV boxes w/ HW reheat coils, new thermostats and VFD's on fan motors is shown on p. HS7-6.

The Construction Cost Estimate for this ECO is shown on p. HS7-7. Details of the variable frequency drive and isolating transformer costs are tabulated on p. HS7-8. The VAV terminal replacement includes VAV RH box, ductwork, insulation, box balancing and diffuser/register for 63 existing reheat boxes, as shown on p. HS7-9 from 1996 Means Mechanical.

Fan Energy Savings: (from spreadsheet calculations)

AHU-4E	Supply	273,827 kwh/YR	(HS7-4)
AHU-4E	Return	68,289	(HS7-5)
AHU-4W	Supply	273,827	(HS7-4)
AHU-4W	Return	68,289	(HS7-5)

Total Elec. Savings = 684,232 $\frac{kwh}{YR}$

$$684{,}232\ \frac{kwh}{YR} \times 3413\ \frac{Btu}{kwh} \times \frac{1\ mBtu}{10^6\ Btu} = \underline{2335.3\ \frac{mBtu}{YR}}$$

This is a simple hand calculation. Computer simulation results were used in the final evaluation (p. HS7-11).

Air Flows for Hospital, 4th Floor
Filename: VAV-4FL.WB2
Location: Fort Gordon, GA

			Supply		Return		Exhaust	
Plan Area	AHU	Zone	Duct Size	CFM	Duct Size	CFM	Duct Size	CFM
A & B	4 W	Northwest	22	8230	54 x 20	7430	10 x 8	190
A & B	4 W	Southwest	22	8625	52 x 20	7320	14 x 8	320
C & B	4 E	Northeast	18 x 18	6190	52 x 16	6250	20 x 14	1415
C & B	4 E	Southeast	20 x 20	7610	62 x 18	5905	26 x 12	1435

A & B	4 W	4th Fl, West	16855	14750	510
Percent of design cfm			21%	25%	3%
C & B	4 E	4th Fl, East	13800	12155	2850
Percent of design cfm			16%	18%	13%
4th Floor	4E & 4W	4th Fl, All	30655	26905	3360
Percent of design cfm			18%	21%	9%
Design	4 W	West, All	80500	59885	16665
Actual	4 W	West, All	102000	64710	37330
Design	4 E	East, All	85265	65935	21945
Actual	4 E	East, All	107000	76250	30700

(1) Assumes exhaust air cfm is equal to outside air cfm.

Variable Frequency Drive Preliminary Analysis 03/01/96
Filename: ECO-HS7a.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	125 bhp	Exist. Control :	N/C
Motor Eff.:	93.0 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

			INPUT HORSEPOWER				HORSEPOWER * HOURS			
Oper Hr/Day	%Oper Hours	%Flow Req'd	N/C	DMPR	VIV	VFD	N/C	DMPR	VIV	VFD
6.0	0.25	100%	125.00	125.00	125.00	125.00	273,750	273,750	273,750	273,750
6.0	0.25	90%	125.00	121.25	106.25	91.13	273,750	265,538	232,688	199,564
12.0	0.50	80%	125.00	118.75	87.50	64.00	547,500	520,125	383,250	280,320
0.0	0.00	70%	125.00	112.50	81.25	42.87	0	0	0	0
0.0	0.00	60%	125.00	106.25	75.00	27.00	0	0	0	0
0.0	0.00	50%	125.00	100.00	68.75	15.63	0	0	0	0
0.0	0.00	40%	125.00	93.75	62.50	8.00	0	0	0	0
24.0	1.00				Totals		1,095,000	1,059,413	889,688	753,634

	Energy Use		Energy Cost	
N/C = No Control	878,355	kWh/Yr	$22,837	/Yr
DMPR = Outlet Damper	849,808	kWh/Yr	$22,095	/Yr
VIV = Vari. Inlet Vane	713,663	kWh/Yr	$18,555	/Yr
VFD = Vari. Freq. Drive	604,528	kWh/Yr	$15,718	/Yr

Annual Savings for: VFD vs N/C

Energy Savings =	273,827	kWh/Year
Cost Savings =	$7,120	/Year

Notes:
1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

HS7-4

Variable Frequency Drive Preliminary Analysis 03/01/96
Filename: ECO-HS7b.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	30 bhp	Exist. Control :	N/C
Motor Eff.:	89.5 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

			INPUT HORSEPOWER				HORSEPOWER * HOURS			
Oper Hr/Day	%Oper Hours	%Flow Req'd	N/C	DMPR	VIV	VFD	N/C	DMPR	VIV	VFD
6.0	0.25	100%	30.00	30.00	30.00	30.00	65,700	65,700	65,700	65,700
6.0	0.25	90%	30.00	29.10	25.50	21.87	65,700	63,729	55,845	47,895
12.0	0.50	80%	30.00	28.50	21.00	15.36	131,400	124,830	91,980	67,277
0.0	0.00	70%	30.00	27.00	19.50	10.29	0	0	0	0
0.0	0.00	60%	30.00	25.50	18.00	6.48	0	0	0	0
0.0	0.00	50%	30.00	24.00	16.50	3.75	0	0	0	0
0.0	0.00	40%	30.00	22.50	15.00	1.92	0	0	0	0
24.0	1.00				Totals		262,800	254,259	213,525	180,872

	Energy Use	Energy Cost
N/C = No Control	219,049 kWh/Yr	$5,695 /Yr
DMPR = Outlet Damper	211,930 kWh/Yr	$5,510 /Yr
VIV = Vari. Inlet Vane	177,977 kWh/Yr	$4,627 /Yr
VFD = Vari. Freq. Drive	150,760 kWh/Yr	$3,920 /Yr

Annual Savings for: VFD vs N/C

Energy Savings = 68,289 kWh/Year
Cost Savings = $1,776 /Year

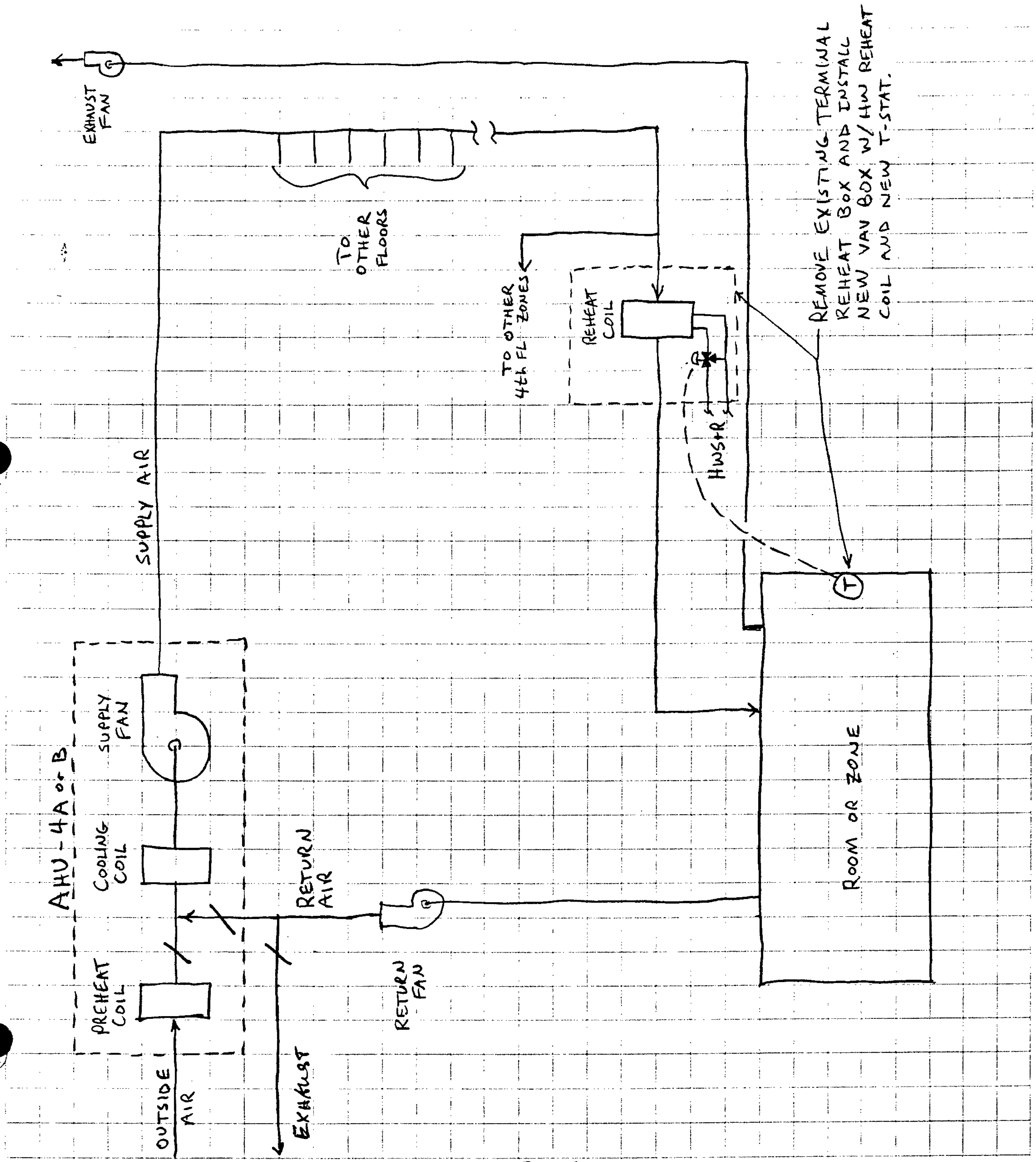
Notes:
1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

RS&H

SUBJECT: FORT GORDON - HOSPITAL
CONVERT TO VAV - 4th FL
DESIGNER: W. Todd
CHECKER:

AEP NO: 694 1331 005
SHEET: OF
DATE: 3-4-96
DATE:

ECO-HS7 (Continued)



CONSTRUCTION COST ESTIMATE

Project:	ECO-HS7, VFD w/Terminal RH Boxes, 4th Floor	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	03/05/96
Basis:	Schematic Design	Estimator:	W. T. Todd
Building:	Eisenhower Army Medical Center	Filename:	est-hs7.wb2

ITEM DESCRIPTION	QUANTITY		MATERIAL		LABOR		TOTAL COST	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total		Material	Labor
VFD w/ Iso Trans, 125 hp	2	Ea	19000	38000	2725	5450	43,450	(1)	(1)
VFD w/ Iso Trans, 30 hp	2	Ea	8000	16000	1465	2930	18,930	(1)	(1)
Remove Exist. RH Boxes	63	Ea		0	60.6	3818	3,818		(2)
VAV Terminal w/ HW RH									
200 CFM	11	Ea	949	10436	1025	11275	21,711	MMp443	MMp443
400 CFM	10	Ea	1156	11558	1394	13940	25,498	MMp443	MMp443
600CFM	12	Ea	1415	16974	1927	23124	40,098	MMp443	MMp443
800 CFM	19	Ea	1570	29825	2235	42456	72,281	MMp443	MMp443
1000 CFM	5	Ea	1725	8625	2522	12608	21,233	MMp443	MMp443
1250 CFM	4	Ea	1639	6555	3096	12382	18,937	MMp443	MMp443
1500 CFM	0	Ea	1811		3670			MMp443	MMp443
2000 CFM	2	Ea	2087	4175	4982	9963	14,138	MMp443	MMp443
Balance air, VAV boxes	63	Ea		0	28.44	1792	1,792		MMp333
DDC Controller, 16 point	1	Ea		0	1961	1961	1,961		MMp317
AI, Static Press. Sensor	4	Ea		0	340	1360	1,360		MMp317
AO, Elec. Controller	4	Ea		0	229	915	915		MMp317
#18-2 wire in 1/2" EMT	6	CLF	7.6	46	29.5	177	223	MEp140	MEp140
Conduit, 1/2" EMT	600	LF	0.3	180	0.54	324	504	MEp105	MEp105
Subtotal Bare Costs				142374		144475	$286,849		
Retrofit Cost Factors			5%	7119	5%	7224	14,343	MMp6	MMp6
Subtotal				149493		151699	301,192		
City Cost Index (Aug. GA)			0%	0	-46%	-69782	(69,782)	MMp533	MMp533
Subtotal				149493		81917	231,410		
OH & Profit Markups			10%	14949	53%	43416	58,365	MMp7	MMp475
Subtotal				164442		125333	289,775		
Sales Taxes			6.0%	9867		NA	9,867	MMp476	
Subtotal				174309		125333	299,642		
Contingency			10%	17431	10%	12533	29,964	MEp6	MEp6
Total Construction Cost				191740		137866	329,606		
Design Fee				NA	6.0%	19776	19,776		
SIOH				NA	6.0%	19776	19,776		
Total Project Cost				191740		177418	$369,158		

LEGEND:

(1)	See VFD cost sheet.
(2)	Assumes 2 manhours per box at $30.30 per hour.
MEp###	1996 Means Electrical Cost Data, page ###.
MMp###	1996 Means Mechanical Cost Data, page ###.

HS7-7

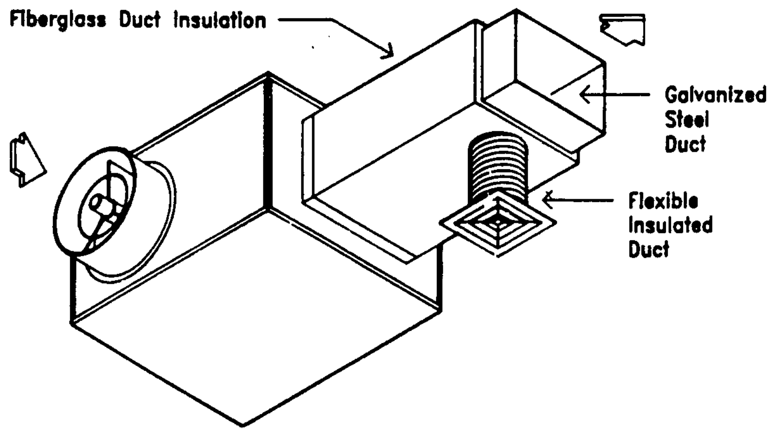
Cost Estimate for Variable Frequency Drive & Installation Feb-96
Filename: VSD_COST.WB2

Motor HP	Variable Frequency Drive Bare Cost, $ (1)			Estim. KVA (2)	Trans. KVA	Isolating Transformer Bare Cost, $ (3)			VFD & Isolating Trans. Total Bare Cost, $		
	Material	Labor	Total			Material	Labor	Total	Material	Labor	Total
3	3150	420	3570	3	3	380	167	547	3530	587	4117
5	3450	420	3870	4	5	485	195	680	3935	615	4550
7.5	3575	500	4075	7	7.5	645	213	858	4220	713	4933
10	3675	500	4175	9	10	800	293	1093	4475	793	5268
15	4025	755	4780	13	15	1200	390	1590	5225	1145	6370
20	4825	755	5580	17	20 *	1313	430	1743	6138	1185	7323
25	5475	995	6470	21	25	1425	470	1895	6900	1465	8365
30	6575	995	7570	25	25	1425	470	1895	8000	1465	9465
40	7275	995	8270	33	37.5	1550	585	2135	8825	1580	10405
50	8300	1275	9575	41	45 *	1725	612	2337	10025	1887	11912
60	9650	1752	11402	49	60 *	2075	666	2741	11725	2418	14143
75	11900	1752	13652	60	75	2425	720	3145	14325	2472	16797
100	13800	1960	15760	80	94 *	2913	743	3655	16713	2703	19415
125	15600	1960	17560	100	112.5	3400	765	4165	19000	2725	21725
150	19200	1960	21160	119	150	4375	807	5182	23575	2767	26342
200	22200	2375	24575	158	188 *	5113	932	6044	27313	3307	30619
250 *	25200	2790	27990	196	225	5850	1056	6906	31050	3846	34896

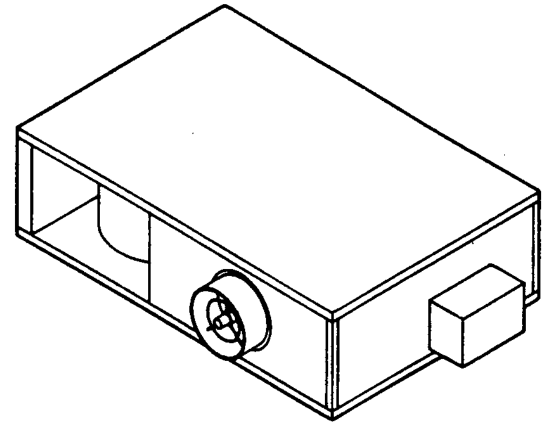
NOTES:

1. Costs for VFD's from Means Electrical Cost Data, 1996, pages 178 & 179.
2. Assumes motor efficiency for GE, standard efficiency, 3 phase, ODP motor.
3. Costs for isolating transformers from Means Electrical Cost Data, 1996, page 202.

* Size not listed in Means, costs estimated by interpolation or extrapolation.



VAV Terminal



Fan Powered VAV Terminal

System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM 8.8-710-1010					
VAV TERMINAL, COOLING ONLY, WITH ACTUATOR / CONTROLS, 200 CFM					
Mixing box variable volume 300 to 600CFM, cool only	1.000	Ea.	310.20	65.45	375.65
Ductwork, 12" x 8" fab rect, galv stl, 12 LF	55.000	Lb.	150.70	237.60	388.30
Insulation, ductwork, blanket type, fiberglass, 1" thk, 1-1/2 LB dens	40.000	S.F.	22	76.40	98.40
Diffusers, alum, OB dmpr, clg, perf, 24"x24" panel size, 6"x6"	~~2.000~~	~~Ea.~~	~~136~~	~~45~~	~~181~~
Ductwork, flex, fiberglass fabric, insul, 1" thk, w/ 3/4lb, PE jkt, 6" diam	~~16.000~~	~~L.F.~~	~~29.60~~	~~40.16~~	~~69.76~~
Round volume control damper 6" diam	~~2.000~~	~~Ea.~~	~~55~~	~~31~~	~~86~~
VAV box balancing	1.000	Ea.		43.60	43.60
Diffuser/register, high, balancing	2.000	Ea.		131	131
TOTAL			482.90 701.50 69%	554.05 672.21 82%	1,373.71

8.8-710 VAV Terminal, Cooling Only

		COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
1010	VAV Terminal, cooling only, with actuator / controls, 200 CFM	700	670	1,370
1020	400 CFM	1,000	1,200	2,200
1030	600 CFM	1,375	1,775	3,150
1040	800 CFM	1,600	2,150	3,750
1050	1000 CFM	1,825	2,475	4,300
1060	1250 CFM	1,650	3,175	4,825
1070	1500 CFM	1,825	3,725	5,550
1080	2000 CFM	2,175	5,300	7,475

8.8-715 VAV Terminal, Hot Water Reheat

		COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
1010	VAV Terminal, cooling, HW reheat, with actuator / controls, 200 CFM	1,375	1,250	2,625
1020	400 CFM	1,675	1,700	3,375
1030	600 CFM	2,050	2,350	4,400
1040	800 CFM	2,275	2,725	5,000
1050	1000 CFM	2,500	3,075	5,575
1060	1250 CFM	2,375	3,775	6,150
1070	1500 CFM	2,625	4,475	7,100
1080	2000 CFM	3,025	6,075	9,100

8.8-720 Fan Powered VAV Terminal, Cooling Only

		COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
1010	VAV Terminal, cooling, fan powrd, with actuator / controls, 200 CFM	1,150	670	1,820
1020	400 CFM	1,275	1,100	2,375

HS7-9

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: HS7
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-HS7 VARIABLE AIR VOLUME CONTROLS
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT
A. CONSTRUCTION COST $ 329600.
B. SIOH $ 19776.
C. DESIGN COST $ 19776.
D. TOTAL COST (1A+1B+1C) $ 369152.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 369152.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	2472.	$ 18837.	13.68	$ 257685.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	1880.	$ 5076.	17.25	$ 87561.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		4352.	$ 23913.		$ 345246.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 23913.

5. SIMPLE PAYBACK PERIOD (1G/4) 15.44 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 345246.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .94
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 4.25 %

HS7- 10

```
*****************************************************************************
*****************************************************************************
**                                                                         **
**                T R A C E   6 0 0   A N A L Y S I S                      **
**                                                                         **
**                by  C.D.S. MARKETING                                     **
**                                                                         **
*****************************************************************************
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```

EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
4TH FLOOR VAV   ECO # HS7

ENERGY SAVINGS

ELEC (kwh)	NGAS (therms)
22,118,931	622,460
21,394,592	603,657
724,339	18,803
2472 MBtu	1880 MBtu

Weather File Code:	AUGUSTA	
Location:		
Latitude:	33.0	(deg)
Longitude:	82.0	(deg)
Time Zone:	5	
Elevation:	143	(ft)
Barometric Pressure:	29.8	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	95	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	23	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

Design Simulation Period: July   To July
System Simulation Period: January   To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 16:28:10   6/27/96
Dataset Name: VAV .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,486,672	2,653	76,919	2,013	188
Feb	1,318,831	2,646	71,859	1,797	188
March	1,623,352	2,748	58,231	2,087	183
April	1,741,147	2,906	43,917	2,309	163
May	1,913,684	3,324	39,715	2,761	156
June	2,119,591	3,591	34,552	3,501	152
July	2,224,305	3,579	36,565	3,737	153
Aug	2,200,499	3,633	36,580	3,727	154
Sept	1,967,324	3,460	37,778	2,993	156
Oct	1,678,467	2,836	50,616	2,075	168
Nov	1,569,445	2,792	53,283	1,943	178
Dec	1,551,276	2,686	63,644	1,941	185
Total	21,394,592	3,633	603,657	30,885	188

Building Energy Consumption = 182,086 (Btu/Sq Ft/Year)   Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 385,813 (Btu/Sq Ft/Year)

H57-12

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

--- U T I L I T Y   P E A K   C H E C K S U M S ---

Utility ELECTRIC DEMAND

Peak Value 3,633.3 (kW)
Yearly Time of Peak 18 (hr) 8 (mo)

Hour 18 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	763.8	21.02
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	606.7	16.70
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.8	0.74
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	63.5	1.75
Sub Total			1,460.8	40.21
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.54
Sub Total			56.0	1.54
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.82
2		SUMMATION OF FAN ELECTRICAL DEMAND	102.1	2.81
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.28
4		SUMMATION OF FAN ELECTRICAL DEMAND	95.2	2.62
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.59
6		SUMMATION OF FAN ELECTRICAL DEMAND	34.7	0.96
7		SUMMATION OF FAN ELECTRICAL DEMAND	88.9	2.45
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.4	0.23
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	2.09
Sub Total			613.4	16.88
Sub Total			0.0	0.00
Miscellaneous				
Lights			732.6	20.16
Base Utilities			0.0	0.00
Misc Equipment			770.6	21.21
Sub Total			1,503.1	41.37
Grand Total			3,633.3	100.00

HS 7-13

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

-- CALIFORNIA TITLE 24 COMPLIANCE REPORT --

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

-------------------------------------- E N E R G Y   U S E   S U M M A R Y --------------------------------------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	33,426,844.0	376.9	25.4	36,639,784.0	51.3
Primary Cooling						
Compressor	2,657,819.7	0.0	0.0	6.8	27,216,136.0	38.1
Tower/Cond Fans	529,973.2	0.0	30,204.2	1.4	5,426,938.0	7.6
Condenser Pump	1,013,159.9	0.0	0.0	2.6	10,374,782.0	14.5
Other Accessories	814,240.9	0.0	0.0	2.1	8,337,846.0	11.7
Auxiliary						
Supply Fans	4,918,287.0	0.0	0.0	12.6	50,363,376.0	70.5
Circulation Pumps	675,625.7	0.0	0.0	1.7	6,918,423.0	9.7
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	5,593,912.5	0.0	0.0	14.3	57,281,796.0	80.2
Lighting	5,344,352.5	0.0	0.0	13.7	54,726,296.0	74.7
Receptacle	5,299,176.5	0.0	0.0	13.6	54,263,692.0	74.1
Domestic Hot Water	0.0	26,938,826.0	303.7	20.2	28,356,660.0	38.7
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	21,394,590.0	60,365,672.0	30,884.9	100.0	282623904.0	390.8

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: 4TH FLOOR VAV

Card 08--------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09------------------- Load Simulation Periods -------------------------

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10------------- Load Simulation Parameters ---------------------

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11--------- Energy Simulation Parameters -----------------

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	BASELINE

Card 25 -- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
534	1										
M610	1			10	1.04	0.9	3	3			
612	1										
614	1										
620	1										
622	1										
630	1										
632	1										
634	1										
710	1										
712	1										
714	1										
720	1										
722	1										
724	1										
M900	1			20	1.04	1.		3			
902	1										
904	1										
906	1										

Card 26 -- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
M100	A-P8HPD	A-L8HPD	AVAIL	OFF		AVAIL	AVAIL	AVAIL	AVAIL	
160	AVAIL	AVAIL								
170	AVAIL	AVAIL								
180	AVAIL	AVAIL								
190	NONE	NONE	NONE	NONE		NONE	NONE			
M210	AVAIL	AVAIL	AVAIL	AVAIL		AVAIL	AVAIL	AVAIL	AVAIL	
240	NONE	NONE	NONE	NONE		NONE	NONE			
M300	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
302						A-MODSKF			A-MODSKF	
330	A-P8HPD	A-L8HPD								
332	A-P8HPD	A-L8HPD								
334	A-P8HPD	A-L8HPD								
350	NONE	NONE	NONE	NONE		NONE	NONE			
M400	A-P8HPD	A-L8HPD	AVAIL	AVAIL	A-VAV					
M510	AVAIL	AVAIL	AVAIL	OFF		AVAIL	AVAIL		AVAIL	
M610	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
800	NONE	NONE	NONE	NONE		NONE	NONE			
810	NONE	NONE	NONE	NONE		NONE	NONE			

FAN MINIMUM
4Th FLOOR ONLY

HS7-16

Card 65-- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	11																

Card 67--------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
2	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
3	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						

Card 69--------------------- Fan Equipment Parameters --------------------------

System Set Number	Cooling Fan	Heating Fan	Return Fan	Exhaust Fan	Auxiliary Supply	Room Exhaust	Optional Ventilation
1	EQ4001		EQ4004			SAMPLE-F	
2	EQ4001		EQ4004			SAMPLE-F	
3	EQ4001					SAMPLE-F	
4	EQ4280		EQ4904			SAMPLE-F	
5	EQ4001					SAMPLE-F	
6	EQ4001					SAMPLE-F	
7	EQ4280		EQ4904			SAMPLE-F	
8	EQ4001					SAMPLE-F	
9	EQ4001					SAMPLE-F	
10	EQ4001					SAMPLE-F	
11	EQ4000					EQ4000	

VSD on supply and return fans
4E & 4W

Card 70------------------- Fan Equipment KW Overrides ----------------------

System Set Number	-----MAIN SYSTEM----- Cool Fan KW	Heat Fan KW	Ret Fan KW	Exh Fan KW	--OTHER SYSTEM-- Aux Sup KW	Room Exh KW	Opt Vent KW	----DEMAND LIMIT PRIORITY--- Cool Fan	Heat Fan	Aux Fan	Room Exh Fan	Opt Vent Fan
1	80		25									
2	80		25									
3	80											
4	100		13									
5	17											
6	33											
7	100		13									
8												
9												
10	16					60						
11												

HS7-17

Utility Description Reference Table

```
    Schedules:
         A-L8HPD  LIGHTS 8HR/DA
         A-MODSKF  KIT FAN MOD SCH
         A-P8HPD  PEOPLE 8HR/DA
         A-VAV  4TH FLOOR VAV SCHEDULE
         AVAIL  AVAILABLE (100%)
         BLGBASE2  HOSPITAL BLG TEMPLATE HOT WATER SCHEDULE
         CL_76  COOLING TSTAT - CONST 76F
         HOTRLGT  HOTEL ROOMS LIGHTS
         HT_75  HEATING TSTAT - CONST 75F
         NONE  ANY PROJECT
         OFF  ALWAYS OFF
    System:
         FC  FAN COIL
         FPVAV  FAN POWERED VAV
         PTAC  PACKAGED TERMINAL AIR COND.
         UV  UNIT VENTILATOR
         VRH  VARIABLE VOLUME REHEAT
    Equipment:
         Cooling:
              EQ1001L   2-STG CENTRIFUGAL CHILLER >550 TONS
              EQ1120L  AIR-CLD RECIPROCATING > 22 TONS
              EQ1307  PACKAGED TERMINAL AIR CONDITIONER
              THRMCHHE  TRANE DIRECT FIRED ABSORBER, 1.07 COP
         Heating:
              EQ2002  GAS FIRED STEAM BOILER
         Fan:
              EQ4000  PREVENTS CONSUMPTION OF FAN ENERGY
              EQ4001  AIR FOIL CENTRIFUGAL - CONSTANT VOLUME
              EQ4004  AXIAL FLOW - CONSTANT VOLUME (MODEL Q)
              EQ4280  AIR FOIL FAN W\VARIABLE SPEED DRIVE
              EQ4904  VANE AXIAL FLOW FAN WITH VFD
              SAMPLE-F  SAMPLE GENERIC FAN
              Tower:
                   EQ5100  COOLING TOWER FANS
           Misc:
               EQ5003  CHILLED WATER PUMP-VAV(SAME AS EQ5007)
```

HS7-18

Schedule Name: A-VAV
Project: 4TH FLOOR VAV SCHEDULE — FOR MIN. POSITION
Location: EISENHOWER AMC
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: WKDY

Hour	Util Percent
0	10
6	25
17	10
24	

Starting Month: JAN Ending Month: DEC
Starting Day Type: SAT Ending Day Type: SUN

Hour	Util Percent
0	10
24	

RS&H

SUBJECT ECO-HS13
Ft. Gordon
DESIGNER B. Todd
CHECKER T. Todd

AEP NO 694-1331-005
SHEET ____ OF ____
DATE 3-1-96
DATE ____

ECO-HS13 Use Damper Controls to Shut Off Air to Unoccupied Areas

AHU-4E and AHU-4W serve the 4th through 11th floors of the hospital. The 4th floor is primarily administrative offices which are only occupied during regular business hours. For this project evaluation, it is assumed that the 4th floor air will be turned off from 6 pm to 6 am.

Since one AHU serves many floors, outlet dampers and variable inlet vanes would not be suitable damper controls to reduce the air flow to the fourth floor because these controls would reduce air to all areas. Variable frequency drives on the supply, return & exhaust fan motors with motorized dampers can be used effectively in this application and are evaluated here.

The fans serving the 4th floor are listed on p. HS13-3, as well as the proposed AHU control diagram. Air flows for the 4 zones of the 4th floor are shown on p. HS13-4. From these calculations, the percents of design cfm that the 4th floor uses out of the total cfm for AHU's 4E & 4W is estimated at 20% supply, 20% return and 10% exhaust.

Energy savings shown on this page are results of simple hand calculations. Computer simulation results are use in the final evaluation (p. HS13-13).

Energy Savings for the 125 hp, 30 hp, 7.5 hp and 5 hp fan motors are calculated on p. HS13-5 through p. HS13-8. BHP is assumed to equal HP. Efficiencies are from Grainger for standard efficiency General Electric, 3 phase ODP motors.

Total energy savings = 2(214,319) + 2(53,448) + 7767 + 5271 = 548,572 kWh/yr
Total cost savings = 2(5572) + 2(1390) + 202 + 137 = $14,263/yr

RS&H

SUBJECT ECO-HS13
F. Gordon
DESIGNER B. Todd
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AEP NO 694-1331-005
SHEET ______ OF ______
DATE 3-1-96
DATE ______

ECO-HS13 (cont.)

The Construction Cost Estimate for this ECO is shown on p. #S13-9. Details of the variable frequency drive and isolating transformer costs are tabulated on p. #S13-10. Details of the VAV damper with motor costs are on p. #S13-11. Actual duct sizes are shown on the Construction Cost Estimate, although the replacements may be a different size and may require multiple units as listed on p. #S13-11.

RS&H

SUBJECT ECO-HS13

DESIGNER B. Todd

CHECKER T. Todd

AEP NO 694-1331-005

SHEET ______ OF ______

DATE 3-1-96

DATE ______

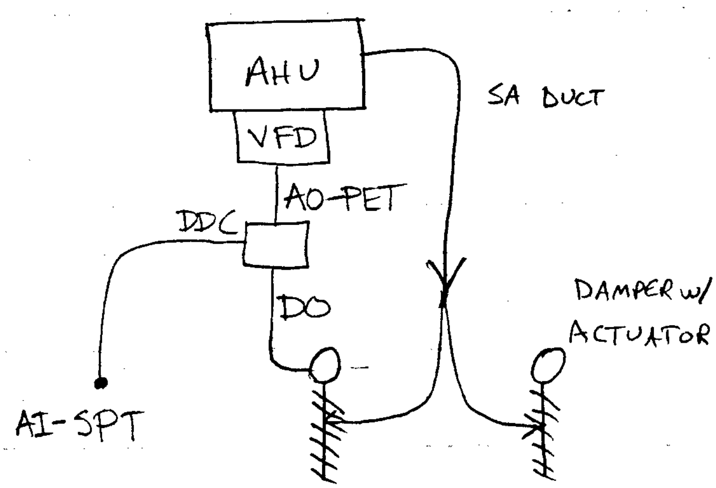
Motors - Variable Frequency Drives

AHU	FAN TYPE	FAN #	MOTOR HP
4W	SUPPLY	SF-4A	125
	RETURN	RA-2A	30
	EXHAUST	EF-1	5
4E	SUPPLY	SF-4B	125
	RETURN	RA-2B	30
	EXHAUST	EF-2	7.5

- FROM AIR FLOWS SPREADSHEET,

SUPPLY % REDUCTION ≅ 20%
RETURN % REDUCTION ≅ 20%
EXHAUST % REDUCTION ≅ 10%

Vary fan speed as needed to maintain a constant pressure at the static pressure sensor for system.
Revert to full speed on failure.



Air Flows for Hospital, 4th Floor
Filename: VAV-4FL.WB2
Location: Fort Gordon, GA

			Supply		Return		Exhaust	
Plan Area	AHU	Zone	Duct Size	CFM	Duct Size	CFM	Duct Size	CFM
A & B	4 W	Northwest	22 ∅	8230	54 x 20	7430	10 x 8	190
A & B	4 W	Southwest	22 ∅	8625	52 x 20	7320	14 x 8	320
C & B	4 E	Northeast	18 x 18	6190	52 x 16	6250	20 x 14	1415
C & B	4 E	Southeast	20 x 20	7610	62 x 18	5905	26 x 12	1435

A & B	4 W	4th Fl, West	16855	14750	510
Percent of design cfm			21%	25%	3%
C & B	4 E	4th Fl, East	13800	12155	2850
Percent of design cfm			16%	18%	13%
4th Floor	4E & 4W	4th Fl, All	30655	26905	3360
Percent of design cfm			18%	21%	9%
Design	4 W	West, All	80500	59885	16665
Actual	4 W	West, All	102000	64710	37330
Design	4 E	East, All	85265	65935	21945
Actual	4 E	East, All	107000	76250	30700

(1) Assumes exhaust air cfm is equal to outside air cfm.

Variable Frequency Drive Preliminary Analysis 03/01/96
Filename: ECOHS13a.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	125 bhp	Exist. Control :	N/C
Motor Eff.:	93.0 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

Oper Hr/Day	%Oper Hours	%Flow Req'd	INPUT HORSEPOWER N/C	DMPR	VIV	VFD	HORSEPOWER * HOURS N/C	DMPR	VIV	VFD
12.0	0.50	100%	125.00	125.00	125.00	125.00	547,500	547,500	547,500	547,500
0.0	0.00	90%	125.00	121.25	106.25	91.13	0	0	0	0
12.0	0.50	80%	125.00	118.75	87.50	64.00	547,500	520,125	383,250	280,320
0.0	0.00	70%	125.00	112.50	81.25	42.87	0	0	0	0
0.0	0.00	60%	125.00	106.25	75.00	27.00	0	0	0	0
0.0	0.00	50%	125.00	100.00	68.75	15.63	0	0	0	0
0.0	0.00	40%	125.00	93.75	62.50	8.00	0	0	0	0
24.0	1.00				Totals		1,095,000	1,067,625	930,750	827,820

	Energy Use	Energy Cost
N/C = No Control	878,355 kWh/Yr	$22,837 /Yr
DMPR = Outlet Damper	856,396 kWh/Yr	$22,266 /Yr
VIV = Vari. Inlet Vane	746,602 kWh/Yr	$19,412 /Yr
VFD = Vari. Freq. Drive	664,036 kWh/Yr	$17,265 /Yr

Annual Savings for: VFD vs N/C

Energy Savings = 214,319 kWh/Year
Cost Savings = $5,572 /Year

Notes:
1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

HS13-5

Variable Frequency Drive Preliminary Analysis — 03/01/96

Filename: ECOHS13b.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	30 bhp	Exist. Control :	N/C
Motor Eff.:	89.5 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

			INPUT HORSEPOWER				HORSEPOWER * HOURS			
Oper Hr/Day	%Oper Hours	%Flow Req'd	N/C	DMPR	VIV	VFD	N/C	DMPR	VIV	VFD
12.0	0.50	100%	30.00	30.00	30.00	30.00	131,400	131,400	131,400	131,400
0.0	0.00	90%	30.00	29.10	25.50	21.87	0	0	0	0
12.0	0.50	80%	30.00	28.50	21.00	15.36	131,400	124,830	91,980	67,277
0.0	0.00	70%	30.00	27.00	19.50	10.29	0	0	0	0
0.0	0.00	60%	30.00	25.50	18.00	6.48	0	0	0	0
0.0	0.00	50%	30.00	24.00	16.50	3.75	0	0	0	0
0.0	0.00	40%	30.00	22.50	15.00	1.92	0	0	0	0
24.0	1.00				Totals		262,800	256,230	223,380	198,677

	Energy Use	Energy Cost
N/C = No Control	219,049 kWh/Yr	$5,695 /Yr
DMPR = Outlet Damper	213,573 kWh/Yr	$5,553 /Yr
VIV = Vari. Inlet Vane	186,192 kWh/Yr	$4,841 /Yr
VFD = Vari. Freq. Drive	165,601 kWh/Yr	$4,306 /Yr

Annual Savings for: VFD vs N/C

Energy Savings =	53,448	kWh/Year
Cost Savings =	$1,390	/Year

Notes:
1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

HS13-6

Variable Frequency Drive Preliminary Analysis

03/01/96

Filename: ECOHS13c.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	7.5 bhp	Exist. Control :	N/C
Motor Eff.:	85.5 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

			INPUT HORSEPOWER				HORSEPOWER * HOURS			
Oper Hr/Day	%Oper Hours	%Flow Req'd	N/C	DMPR	VIV	VFD	N/C	DMPR	VIV	VFD
12.0	0.50	100%	7.50	7.50	7.50	7.50	32,850	32,850	32,850	32,850
12.0	0.50	90%	7.50	7.28	6.38	5.47	32,850	31,864	27,923	23,948
0.0	0.00	80%	7.50	7.13	5.25	3.84	0	0	0	0
0.0	0.00	70%	7.50	6.75	4.88	2.57	0	0	0	0
0.0	0.00	60%	7.50	6.38	4.50	1.62	0	0	0	0
0.0	0.00	50%	7.50	6.00	4.13	0.94	0	0	0	0
0.0	0.00	40%	7.50	5.63	3.75	0.48	0	0	0	0
24.0	1.00				Totals		65,700	64,715	60,773	56,798

	Energy Use	Energy Cost
N/C = No Control	57,324 kWh/Yr	$1,490 /Yr
DMPR = Outlet Damper	56,464 kWh/Yr	$1,468 /Yr
VIV = Vari. Inlet Vane	53,025 kWh/Yr	$1,379 /Yr
VFD = Vari. Freq. Drive	49,557 kWh/Yr	$1,288 /Yr

Annual Savings for: VFD vs N/C

Energy Savings =	7,767 kWh/Year
Cost Savings =	$202 /Year

Notes:
1. Equation for VFD HP is: $HP2 = (Q2/Q1)^3 \times HP1$
2. Q = volume air flow, cfm

HS13-7

Variable Frequency Drive Preliminary Analysis 03/01/96
Filename: ECOHS13d.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	5 bhp	Exist. Control :	N/C
Motor Eff.:	84.0 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

Oper Hr/Day	%Oper Hours	%Flow Req'd	INPUT HORSEPOWER N/C	DMPR	VIV	VFD	HORSEPOWER * HOURS N/C	DMPR	VIV	VFD
12.0	0.50	100%	5.00	5.00	5.00	5.00	21,900	21,900	21,900	21,900
12.0	0.50	90%	5.00	4.85	4.25	3.65	21,900	21,243	18,615	15,965
0.0	0.00	80%	5.00	4.75	3.50	2.56	0	0	0	0
0.0	0.00	70%	5.00	4.50	3.25	1.71	0	0	0	0
0.0	0.00	60%	5.00	4.25	3.00	1.08	0	0	0	0
0.0	0.00	50%	5.00	4.00	2.75	0.63	0	0	0	0
0.0	0.00	40%	5.00	3.75	2.50	0.32	0	0	0	0
24.0	1.00				Totals		43,800	43,143	40,515	37,865

	Energy Use	Energy Cost
N/C = No Control	38,899 kWh/Yr	$1,011 /Yr
DMPR = Outlet Damper	38,315 kWh/Yr	$996 /Yr
VIV = Vari. Inlet Vane	35,981 kWh/Yr	$936 /Yr
VFD = Vari. Freq. Drive	33,628 kWh/Yr	$874 /Yr

Annual Savings for: VFD vs N/C

Energy Savings =	5,271 kWh/Year
Cost Savings =	$137 /Year

Notes:
1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

HS13-8

Cost Estimate for Variable Frequency Drive & Installation
Filename: VSD_COST.WB2

Feb-96

Motor HP	Variable Frequency Drive Bare Cost, $ (1)			Estim. KVA (2)	Trans. KVA	Isolating Transformer Bare Cost, $ (3)			VFD & Isolating Trans. Total Bare Cost, $		
	Material	Labor	Total			Material	Labor	Total	Material	Labor	Total
3	3150	420	3570	3	3	380	167	547	3530	587	4117
5	3450	420	3870	4	5	485	195	680	3935	615	4550
7.5	3575	500	4075	7	7.5	645	213	858	4220	713	4933
10	3675	500	4175	9	10	800	293	1093	4475	793	5268
15	4025	755	4780	13	15	1200	390	1590	5225	1145	6370
20	4825	755	5580	17	20 *	1313	430	1743	6138	1185	7323
25	5475	995	6470	21	25	1425	470	1895	6900	1465	8365
30	6575	995	7570	25	25	1425	470	1895	8000	1465	9465
40	7275	995	8270	33	37.5	1550	585	2135	8825	1580	10405
50	8300	1275	9575	41	45 *	1725	612	2337	10025	1887	11912
60	9650	1752	11402	49	60 *	2075	666	2741	11725	2418	14143
75	11900	1752	13652	60	75	2425	720	3145	14325	2472	16797
100	13800	1960	15760	80	94 *	2913	743	3655	16713	2703	19415
125	15600	1960	17560	100	112.5	3400	765	4165	19000	2725	21725
150	19200	1960	21160	119	150	4375	807	5182	23575	2767	26342
200	22200	2375	24575	158	188 *	5113	932	6044	27313	3307	30619
250 *	25200	2790	27990	196	225	5850	1056	6906	31050	3846	34896

NOTES:

1. Costs for VFD's from Means Electrical Cost Data, 1996, pages 178 & 179.
2. Assumes motor efficiency for GE, standard efficiency, 3 phase, ODP motor.
3. Costs for isolating transformers from Means Electrical Cost Data, 1996, page 202.
* Size not listed in Means, costs estimated by interpolation or extrapolation.

HS13-9.

RS&H

SUBJECT ECO-HS13

DESIGNER B. Todd

CHECKER T. Todd

AEP NO

SHEET ____ OF ____

DATE 3-1-96

DATE

4th Floor Duct Sizes and Damper Costs

	Actual Size	Replacement Qty	Replacement Size	VAV Damper w/ motor $ MAT (ea)	VAV Damper w/ motor $ LABOR (ea)
Supply	22" ϕ	2	24"×12"	144	29
	22" ϕ	2	24"×12"	144	29
	18"×18"	1	18"×18"	139	29
	20"×20"	2	24"×12"	144	29
RETURN	54"×20"	3	18"×20"	151	33
	52"×20"	3	18"×20"	151	33
	52"×16"	2	28"×16"	256	38.5
	62"×18"	2	30"×24"	305	61
EXHAUST	10"×8"	1	10"×10"	117	17.8
	14"×8"	1	16"×10"	121	19.3
	20"×14"	1	20"×14"	142	29
	26"×12"	1	16"×12"	126	21
		1	12"×12"	120	19.3

Source (MATERIALS & LABOR): 1996 Means Mechanical p. 328.

CONSTRUCTION COST ESTIMATE

Project:	ECO-HS13, VFD w/Dampers, 4th Floor	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	03/05/96
Basis:	Schematic Design	Estimator:	W. T. Todd
Building:	Eisenhower Army Medical Center	Filename:	est-hs13.wb2

ITEM DESCRIPTION	QUANTITY		MATERIAL		LABOR		TOTAL	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
VFD w/ Iso Trans, 125 hp	2	Ea	19000	38000	2725	5450	43,450	(1)	(1)
VFD w/ Iso Trans, 30 hp	2	Ea	8000	16000	1465	2930	18,930	(1)	(1)
VFD w/ Iso Trans, 7.5 hp	1	Ea	4220	4220	713	713	4,933	(1)	(1)
VFD w/ Iso Trans, 5 hp	1	Ea	3935	3935	615	615	4,550	(1)	(1)
VAV Damper w/ motor									
NW supply, 22" rnd	1	Ea	288	288	58	58	346	MMp328	MMp328
NW return, 54x20	1	Ea	453	453	99	99	552	MMp328	MMp328
NW Exh., 10x8	1	Ea	117	117	17.8	18	135	MMp328	MMp328
SW supply, 22" rnd	1	Ea	288	288	58	58	346	MMp328	MMp328
SW return, 52x20	1	Ea	453	453	99	99	552	MMp328	MMp328
SW Exh., 14x8	1	Ea	121	121	19.3	19	140	MMp328	MMp328
NE supply, 18x18	1	Ea	139	139	29	29	168	MMp328	MMp328
NE return, 52x16	1	Ea	512	512	77	77	589	MMp328	MMp328
NE Exh., 20x14	1	Ea	142	142	29	29	171	MMp328	MMp328
SE supply, 20X20	1	Ea	288	288	58	58	346	MMp328	MMp328
SE return, 62X18	1	Ea	610	610	122	122	732	MMp328	MMp328
SE Exh., 26X12	1	Ea	246	246	40.3	40	286	MMp328	MMp328
Transformer, 40VA	12	Ea	23.5	282	14.5	174	456	MMp328	MMp328
DDC Controller, 32 point	1	Ea		0	3269	3269	3,269		MMp317
AI, Static Press. Sensor	6	Ea		0	340	2040	2,040		MMp317
AO, Elec. Controller	6	Ea		0	229	1373	1,373		MMp317
DO, On/Off Control	12	Ea		0	360	4315	4,315		MMp317
#18-2 wire in 1/2" EMT	27	CLF	7.6	205	29.5	797	1,002	MEp140	MEp140
Conduit, 1/2" EMT	900	LF	0.3	270	0.54	486	756	MEp105	MEp105
Subtotal Bare Costs				66569		22868	$89,437		
Retrofit Cost Factors			5%	3328	5%	1143	4,471	MMp6	MMp6
Subtotal				69897		24011	93,908		
City Cost Index (Aug. GA)			0%	0	-46%	-11045	(11,045)	MMp533	MMp533
Subtotal				69897		12966	82,863		
OH & Profit Markups			10%	6990	53%	6872	13,862	MMp7	MMp475
Subtotal				76887		19838	96,725		
Sales Taxes			6.0%	4613		NA	4,613	MMp476	
Subtotal				81500		19838	101,338		
Contingency			10%	8150	10%	1984	10,134	MEp6	MEp6
Total Construction Cost				89650		21822	111,472		
Design Fee				NA	6.0%	6688	6,688		
SIOH				NA	6.0%	6688	6,688		
Total Project Cost				89650		35198	$124,848		

LEGEND:

(1)	See VFD cost sheet.
MEp###	1996 Means Electrical Cost Data, page ###.
MMp###	1996 Means Mechanical Cost Data, page ###.

HS13-11

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: HS13
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-HS13 SHUT OF AIR W/ DAMPER CONTROLS
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT
A. CONSTRUCTION COST $ 111500.
B. SIOH $ 6690.
C. DESIGN COST $ 6690.
D. TOTAL COST (1A+1B+1C) $ 124880.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 124880.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	2041.	$ 15552.	13.68	$ 212757.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	1505.	$ 4064.	17.25	$ 70095.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		3546.	$ 19616.		$ 282853.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 19616.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.37 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 282853.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.26
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.96 %

HS13 - 12

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******************************************************************************
******************************************************************************
**                                                                          **
**                    T R A C E   6 0 0   A N A L Y S I S                   **
**                                                                          **
**                    by  C.D.S. MARKETING                                  **
**                                                                          **
******************************************************************************
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EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
SCHEDULE AIR TO 4TH FLOOR

ECO # HS13 DAMPER Controls

			ELC (kWh)	NGAS (therms)
Weather File Code:	AUGUSTA			
Location:				
Latitude:	33.0	(deg)		
Longitude:	82.0	(deg)	22,118,931	622,460
Time Zone:	5			
Elevation:	143	(ft)	21,521,022	607,408
Barometric Pressure:	29.8	(in. Hg)		
			597,909	15,052
Summer Clearness Number:	0.90			
Winter Clearness Number:	0.90			
Summer Design Dry Bulb:	95	(F)	2041 MBTU	1505 MBTU
Summer Design Wet Bulb:	76	(F)		
Winter Design Dry Bulb:	23	(F)		
Summer Ground Relectance:	0.20			
Winter Ground Relectance:	0.20			

Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

Design Simulation Period: July To July
System Simulation Period: January To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 14:30:42 6/27/96
Dataset Name: DAMPER .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,499,168	2,701	77,316	2,029	188
Feb	1,329,888	2,698	72,127	1,806	188
March	1,635,049	2,793	58,684	2,107	183
April	1,750,917	2,941	44,268	2,330	163
May	1,922,752	3,324	40,014	2,780	156
June	2,126,510	3,604	34,758	3,515	152
July	2,235,160	3,599	36,769	3,751	153
Aug	2,212,806	3,628	36,801	3,741	154
Sept	1,978,412	3,459	37,986	3,006	156
Oct	1,688,798	2,870	50,985	2,093	168
Nov	1,579,336	2,825	53,652	1,958	178
Dec	1,562,227	2,730	64,046	1,958	185
Total	21,521,022	3,628	607,408	31,072	188

Building Energy Consumption = 183,187 (Btu/Sq Ft/Year)   Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 388,119 (Btu/Sq Ft/Year)

H313-14

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

---------- U T I L I T Y   P E A K   C H E C K S U M S ----------

Utility ELECTRIC DEMAND

Peak Value 3,628.3 (kW)
Yearly Time of Peak 18 (hr) 8 (mo)

Hour 18 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	761.9	21.00
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	604.7	16.66
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.8	0.74
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	63.5	1.75
Sub Total			1,456.9	40.15
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.54
Sub Total			56.0	1.54
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.82
2		SUMMATION OF FAN ELECTRICAL DEMAND	102.1	2.81
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.28
4		SUMMATION OF FAN ELECTRICAL DEMAND	94.9	2.62
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.59
6		SUMMATION OF FAN ELECTRICAL DEMAND	34.7	0.96
7		SUMMATION OF FAN ELECTRICAL DEMAND	88.1	2.43
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.4	0.23
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	2.09
Sub Total			612.3	16.88
Sub Total			0.0	0.00
Miscellaneous				
Lights			732.6	20.19
Base Utilities			0.0	0.00
Misc Equipment			770.6	21.24
Sub Total			1,503.1	41.43
Grand Total			3,628.3	100.00

HS13-15

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

-- CALIFORNIA TITLE 24 COMPLIANCE REPORT --

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

-------------------------------------- E N E R G Y U S E S U M M A R Y --------------------------------------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	33,801,960.0	378.8	25.6	37,034,640.0	51.8
Primary Cooling						
Compressor	2,668,985.2	0.0	0.0	6.8	27,330,472.0	38.2
Tower/Cond Fans	536,585.9	0.0	30,391.1	1.4	5,494,652.5	7.7
Condenser Pump	1,020,989.8	0.0	0.0	2.6	10,454,960.0	14.6
Other Accessories	815,059.0	0.0	0.0	2.1	8,346,223.5	11.7
Auxiliary						
Supply Fans	5,016,097.5	0.0	0.0	12.8	51,364,956.0	71.9
Circulation Pumps	677,818.1	0.0	0.0	1.7	6,940,873.0	9.7
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	5,693,915.5	0.0	0.0	14.5	58,305,828.0	81.6
Lighting	5,344,352.5	0.0	0.0	13.6	54,726,296.0	74.7
Receptacle	5,299,176.5	0.0	0.0	13.5	54,263,692.0	74.1
Domestic Hot Water	0.0	26,938,834.0	301.9	20.1	28,356,668.0	38.7
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	21,521,020.0	60,740,792.0	31,071.7	100.0	284313440.0	393.1

HS 13-16

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: SCHEDULE AIR TO 4TH FLOOR

Card 08--------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09------------------- Load Simulation Periods ------------------------

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10------------- Load Simulation Parameters ---------------------

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11--------- Energy Simulation Parameters -----------------

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	BASELINE

H313-17

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
534	1										
M610	1			10	1.04	0.9	3	3			
612	1										
614	1										
620	1										
622	1										
630	1										
632	1										
634	1										
710	1										
712	1										
714	1										
720	1										
722	1										
724	1										
M900	1			20	1.04	1.		3			
902	1										
904	1										
906	1										

Card 26-- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
M100	A-P8HPD	A-L8HPD	AVAIL	OFF		AVAIL	AVAIL	AVAIL	AVAIL	
160	AVAIL	AVAIL								
170	AVAIL	AVAIL								
180	AVAIL	AVAIL								
190	NONE	NONE	NONE	NONE		NONE	NONE			
M210	AVAIL	AVAIL	AVAIL	AVAIL		AVAIL	AVAIL	AVAIL	AVAIL	
240	NONE	NONE	NONE	NONE		NONE	NONE			
M300	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
302						A-MODSKF			A-MODSKF	
330	A-P8HPD	A-L8HPD								
332	A-P8HPD	A-L8HPD								
334	A-P8HPD	A-L8HPD								
350	NONE	NONE	NONE	NONE		NONE	NONE			
M400	A-P8HPD	A-L8HPD	AVAIL	AVAIL	A-DAMPER					
M510	AVAIL	AVAIL	AVAIL	OFF		AVAIL	AVAIL		AVAIL	
M610	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
800	NONE	NONE	NONE	NONE		NONE	NONE			
810	NONE	NONE	NONE	NONE		NONE	NONE			

schedules damper minimum position
4th floor only

Card 65-- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	11																

Card 67-------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
2	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
3	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						

Card 69--------------------- Fan Equipment Parameters --------------------------

System Set Number	Cooling Fan	Heating Fan	Return Fan	Exhaust Fan	Auxiliary Supply	Room Exhaust	Optional Ventilation
1	EQ4001		EQ4004			SAMPLE-F	
2	EQ4001		EQ4004			SAMPLE-F	
3	EQ4001					SAMPLE-F	
4	EQ4280		EQ4904			SAMPLE-F	
5	EQ4001					SAMPLE-F	
6	EQ4001					SAMPLE-F	
7	EQ4280		EQ4904			SAMPLE-F	
8	EQ4001					SAMPLE-F	
9	EQ4001					SAMPLE-F	
10	EQ4001					SAMPLE-F	
11	EQ4000					EQ4000	

VSD's on AHUs 4 & 7 (4E & 4W) — and return fans

Card 70------------------- Fan Equipment KW Overrides ----------------------

	-----MAIN SYSTEM-----			--OTHER SYSTEM--				----DEMAND LIMIT PRIORITY---				
System Set Number	Cool Fan KW	Heat Fan KW	Ret Fan KW	Exh Fan KW	Aux Sup KW	Room Exh KW	Opt Vent KW	Cool Fan	Heat Fan	Aux Fan	Room Exh Fan	Opt Vent Fan
1	80		25									
2	80		25									
3	80											
4	100		13									
5	17											
6	33											
7	100		13									
8												
9												
10	16					60						
11												

Utility Description Reference Table

```
Schedules:
     A-DAMPER  4TH FLOOR DAMPER SCHEDULE
     A-L8HPD  LIGHTS 8HR/DA
     A-MODSKF  KIT FAN MOD SCH
     A-P8HPD  PEOPLE 8HR/DA
     AVAIL  AVAILABLE (100%)
     BLGBASE2  HOSPITAL BLG TEMPLATE HOT WATER SCHEDULE
     CL_76  COOLING TSTAT - CONST 76F
     HOTRLGT  HOTEL ROOMS LIGHTS
     HT_75  HEATING TSTAT - CONST 75F
     NONE  ANY PROJECT
     OFF  ALWAYS OFF
System:
     FC  FAN COIL
     FPVAV  FAN POWERED VAV
     PTAC  PACKAGED TERMINAL AIR COND.
     UV  UNIT VENTILATOR
     VRH  VARIABLE VOLUME REHEAT
Equipment:
     Cooling:
          EQ1001L   2-STG CENTRIFUGAL CHILLER >550 TONS
          EQ1120L  AIR-CLD RECIPROCATING > 22 TONS
          EQ1307  PACKAGED TERMINAL AIR CONDITIONER
          THRMCHHE  TRANE DIRECT FIRED ABSORBER, 1.07 COP
     Heating:
          EQ2002  GAS FIRED STEAM BOILER
     Fan:
          EQ4000  PREVENTS CONSUMPTION OF FAN ENERGY
          EQ4001  AIR FOIL CENTRIFUGAL - CONSTANT VOLUME
          EQ4004  AXIAL FLOW - CONSTANT VOLUME (MODEL Q)
          EQ4280  AIR FOIL FAN W\VARIABLE SPEED DRIVE
          EQ4904  VANE AXIAL FLOW FAN WITH VFD
          SAMPLE-F  SAMPLE GENERIC FAN
          Tower:
               EQ5100  COOLING TOWER FANS
        Misc:
           EQ5003  CHILLED WATER PUMP-VAV(SAME AS EQ5007)
```

HS13-20

Schedule Name: A-DAMPER
Project: 4TH FLOOR DAMPER SCHEDULE FOR MIN. POSITION
Location: EISENHOWER AMC
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: WKDY

Hour	Util Percent
0	10
6	100
17	10
24	

Starting Month: JAN Ending Month: DEC
Starting Day Type: SAT Ending Day Type: SUN

Hour	Util Percent
0	10
24	

RS&H

SUBJECT

DESIGNER Hutchins

CHECKER

AEP NO

SHEET OF

DATE 3/8/96

DATE

ECO # HS18 Reduce Heated or Cooled Outside Air

Outside Air Flows

Measured

	Supply	OSA	% OSA	
4A	107,000	31,030	29	> avg 33%
4B	102,000	37,740	37	

Required (keeping existing supply air flows)

4A	107,000	24,100	22.5	> avg. 23%
4B	102,000	24,100	23.6	

CONSTRUCTION COST ESTIMATE

Project:	ECO # HS18 Reduce Heated or Cooled Outside Air	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/9/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	EST_HS18.XLS

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Balance AHU	2	ea		$0	$507.00	$1,014	$1,014		MMp332
This estimate includes overhead and profit									
Subtotal Bare Costs				$0		$1,014	$1,014		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$0		$1,014	$1,014		
City Cost Index (Aug. GA)			0%	$0	0%	$0	$0	MMp533	MMp533
				-		-	-		
Subtotal				$0		$1,014	$1,014		
OH & Profit Markups			10%	$0	0%	$0	$0	MMp7	MMp475
				-		-	-		
Subtotal				$0		$1,014	$1,014		
Sales Taxes			6.0%	$0		NA	$0	MMp476	
				-		-	-		
Subtotal				$0		$1,014	$1,014		
Contingency			10%	$0	10%	$101	$101	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$0		$1,115	$1,115		
Design Fee				NA	0.0%	$0	$0		
SIOH				NA	6.0%	$61	$61		
				-		-	-		
Total Project Cost				$0		$1,176	$1,176		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

HS18 -2

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: HS18
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-HS18 REDUCE HEATED & COOLED OUTSIDE AIR
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 1100.			
B. SIOH	$ 66.			
C. DESIGN COST	$ 66.			
D. TOTAL COST (1A+1B+1C)	$ 1232.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 1232.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	136.	$ 1036.	13.68	$ 14177.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	32.	$ 86.	17.25	$ 1490.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		168.	$ 1123.		$ 15667.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 1123.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.10 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 15667.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 12.72
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 18.78 %

HS18-3

```
*******************************************************************************
*******************************************************************************
**                                                                           **
**              T R A C E   6 0 0   A N A L Y S I S                          **
**                                                                           **
**              by  C.D.S. MARKETING                                         **
**                                                                           **
*******************************************************************************
*******************************************************************************
```

EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
OSA REDUCTION   ECO # HS18

Weather File Code:	AUGUSTA	
Location:		
Latitude:	33.0	(deg)
Longitude:	82.0	(deg)
Time Zone:	5	
Elevation:	143	(ft)
Barometric Pressure:	29.8	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	95	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	23	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

ENERGY SAVINGS

ELC (kwh)	NGAS (therms)
22,118,931	622,460
22,078,960	622,137
39,971	323
136 MBTU	32 MBTU

Design Simulation Period: July   To July
System Simulation Period: January   To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 19:10:44   6/26/96
Dataset Name: OSA .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,552,783	2,740	78,233	2,094	188
Feb	1,377,334	2,738	73,339	1,865	188
March	1,691,412	2,829	60,151	2,212	184
April	1,807,434	2,969	45,542	2,451	164
May	1,974,632	3,376	41,192	2,855	158
June	2,160,054	3,620	35,747	3,503	152
July	2,261,782	3,615	37,878	3,738	154
Aug	2,243,318	3,661	37,848	3,722	155
Sept	2,014,967	3,506	39,112	3,053	157
Oct	1,744,879	2,901	52,382	2,200	169
Nov	1,633,376	2,876	55,065	2,051	180
Dec	1,616,987	2,767	65,648	2,055	187
Total	22,078,960	3,661	622,137	31,800	188

Building Energy Consumption = 187,797 (Btu/Sq Ft/Year) Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 398,035 (Btu/Sq Ft/Year)

HS18-5

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

------------------------------------- U T I L I T Y   P E A K   C H E C K S U M S -------------------------------------

Utility ELECTRIC DEMAND

Peak Value 3,661.3 (kW)
Yearly Time of Peak 18 (hr) 8 (mo)

Hour 18 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	753.4	20.58
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	596.0	16.28
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.8	0.73
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	63.5	1.74
Sub Total			1,439.6	39.32
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.53
Sub Total			56.0	1.53
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.79
2		SUMMATION OF FAN ELECTRICAL DEMAND	102.1	2.79
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.26
4		SUMMATION OF FAN ELECTRICAL DEMAND	115.9	3.16
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.59
6		SUMMATION OF FAN ELECTRICAL DEMAND	34.7	0.95
7		SUMMATION OF FAN ELECTRICAL DEMAND	117.4	3.21
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.4	0.23
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	2.08
Sub Total			662.6	18.10
Sub Total			0.0	0.00
Miscellaneous				
Lights			732.6	20.01
Base Utilities			0.0	0.00
Misc Equipment			770.6	21.05
Sub Total			1,503.1	41.05
Grand Total			3,661.3	100.00

HS18-6

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

-- CALIFORNIA TITLE 24 COMPLIANCE REPORT --

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

-------------------------------------- E N E R G Y   U S E   S U M M A R Y --------------------------------------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	35,274,828.0	385.9	26.0	38,585,028.0	54.0
Primary Cooling						
Compressor	2,713,409.7	0.0	0.0	6.7	27,785,380.0	38.9
Tower/Cond Fans	536,170.3	0.0	31,119.7	1.3	5,490,396.0	7.7
Condenser Pump	1,005,827.2	0.0	0.0	2.5	10,299,695.0	14.4
Other Accessories	814,772.4	0.0	0.0	2.0	8,343,289.0	11.7
Auxiliary						
Supply Fans	5,549,719.5	0.0	0.0	13.8	56,829,260.0	79.5
Circulation Pumps	673,572.5	0.0	0.0	1.7	6,897,398.5	9.7
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	6,223,292.0	0.0	0.0	15.4	63,726,656.0	89.2
Lighting	5,344,352.5	0.0	0.0	13.3	54,726,296.0	74.7
Receptacle	5,299,176.5	0.0	0.0	13.1	54,263,692.0	74.1
Domestic Hot Water	0.0	26,938,826.0	294.7	19.6	28,356,660.0	38.7
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	22,078,956.0	62,213,656.0	31,800.3	100.0	291577088.0	403.3

HS18-7

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: OSA REDUCTION

Card 08 - Climatic Information

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09 - Load Simulation Periods

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10 - Load Simulation Parameters

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11 - Energy Simulation Parameters

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

Load Section Alternative #1

Card 19- Load Alternative -

Number	Description
1	BASELINE

HS18-8

Card 27------------------------------------ People and Lights ---

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
M	309	SF-PERS	250	200	1.125	WATT-SF	RECFL-RS		75		
160					2.625						
170					2.625						
180					2.625						
190	0	SF-PERS									
240	0	SF-PERS									
350	0	SF-PERS									
400	200	SF-PERS			2.025	WATT-SF					
410	200	SF-PERS			2.025	WATT-SF					
420	200	SF-PERS			2.025	WATT-SF					
430	200	SF-PERS			2.025	WATT-SF					
440	200	SF-PERS			2.025	WATT-SF					
800	0	SF-PERS									
810	0	SF-PERS									
M900	150	SF-PERS			0	WATT-SF					

Card 28-- Miscellaneous Equipment --
--

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
M	1	MISC EQUIP	1.08	WATT-SF	A-L8HPD	ELEC					
160	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
170	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
180	1	MISC EQUIP	5.00	WATT-SF	AVAIL	ELEC					
250	1	MISC EQUIP	3.00	WATT-SF	A-L8HPD	ELEC					
M900	1	MISC ELEC	1.	WATT-SF	HOTRLGT	NONE					

Card 29-- Room Airflows ---

Room	-------------Ventilation------------- -----Cooling-----		-----Heating-----		-------------Infiltration------------ -----Cooling-----		-----Heating-----		--Reheat Minimum--	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
M100	19	PCT-MCLG	19	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
M210	19	PCT-MCLG	19	PCT-MCLG	0.75	ACH-HR	0.75	ACH-HR	100	PCT-MCLG
302	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
330	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
332	100	PCT-MCLG	100	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
334	100	PCT-MCLG	100	PCT-MCLG	0	ACH-HR	0	ACH-HR	100	PCT-MCLG
M400	23	PCT-MCLG	23	PCT-MCLG	0.25	ACH-HR	0.25	ACH-HR	100	PCT-MCLG
M510	100	PCT-MCLG	100	PCT-MCLG					100	PCT-MCLG
M620	23	PCT-MCLG	23	PCT-MCLG	0.25	ACH-HR	0.25	ACH-HR	100	PCT-MCLG
800	0	CFM	0	CFM	0	CFM	0	CFM		
810	0	CFM	0	CFM	0	CFM	0	CFM		
M900	15	PCT-MCLG	15	PCT-MCLG	0.50	ACH-HR	0.50	ACH-HR	100	PCT-MCLG

OSA reduced on all levels except
kitchen make up, OR & ICU

RS&H

SUBJECT ____
DESIGNER ____
CHECKER ____
AEP NO ____
SHEET ____ OF ____
DATE ____
DATE ____

ASHRAE 62-89 Calculation

Requirements	cfm / person
Patient Rooms	25
Medical Procedure	15
Operating Rooms	30
Recovery and ICU	15
Offices	20

Peak hospital occupancy is 2000
Nighttime 400

Assume 300 in-room patients

SF	AREA	PEOPLE	IN-ROOM PATIENTS	OSA
1	88,400	240		4800
2	120,000	340		6800
3	97,000	260		5200
4A	128,525	350	150	10,750
4B	129,295	350	150	10,750
5	14,730	20	10	450
6	20,000	20	30	1500
MRI	2940	10		200
FAM.PRT.	25,976	70		1400
TOTAL	626,866	1660	340	

RS&H

SUBJECT FORT GORDON - EAMC
SCHEDULED SETBACK FOR OR
DESIGNER W. TODD
CHECKER

AEP NO 694 1268 005
SHEET ____ OF ____
DATE 3-7-96
DATE

ECO-HS24 SETBACK SUPPLY AIR TO SURGICAL SUITE

The surgical suite is not typically utilized at night and on weekends. This project will allow the supply and exhaust fans to operate at a reduced capacity during unoccupied times.

This area is served by: (Info from design dwgs.)

SF-6, 27900 cfm supply, 40 hp motor

EF-6, 22900 cfm exhaust, 5 hp motor

Funded Renovation Includes:

- VFD's on SF-6 and EF-6 motors
- Day/night setback software
- Speed control for fans
- Start/stop for fans, time control
- Current transformers on fan motors
- Alarm for fan status

OR Design Requirements: (see pages HS24-6,7,8 & 9)

- 15 Air changes per hour supply air (occupied)
- 5 " " " " outside " "
- 68 to 76 °F, 50-60% RH
- 3 Air changes per hour supply air (unoccupied)

Existing estimated supply air = 8.25 AC/HR

RS&H.

SUBJECT FORT GORDON - EAMC
SCHEDULED SETBACK FOR OR
DESIGNER W. TODD
CHECKER

AEP NO 694 1331 005
SHEET ____ OF ____
DATE 3-7-96
DATE

ECO-HS24 (continued)

$$\text{Design pos. pressure} = \frac{27900 - 22900}{27900} = 0.179$$

Minimum Supply Air = 3 AC per hour

$$\text{Minimum Flow required} = \frac{3\ AC/HR}{8.25\ AC/HR} = 0.36 \Rightarrow \text{say } 40\%$$

Fan operating hours:

- Assume surgical suite is occupied from 6am to 9pm, 5 days/week.
- Assume fans will operate at 100% for a total of 1 hour from 9pm - 6am, M-F.
- Assume fans will operate at 100% for 12 hours/day during weekends.

$$100\%\ \text{op. hrs} = (15+1)\frac{hr}{day} * 5\frac{day}{wk} + 12\frac{hr}{day} \times 2\frac{day}{wk} = 104\ hr/wk$$

$$40\%\ \text{op. hrs.} = 8\frac{hr}{day} \times 5\frac{day}{wk} + 12\frac{hr}{day} \times 2\frac{day}{wk} = 64\ hr/wk$$

Energy Savings: See pages HS24-3 and HS24-4

$$\text{Elec. savings} = 102426\frac{kwh}{YR} + 13018\frac{kwh}{YR} = 115444\frac{kwh}{YR}$$

$$115444\frac{kwh}{YR} \times 3413\frac{Btu}{kwh} \times \frac{1\ MBtu}{10^6\ Btu} = 394\ MBtu/YR$$

This is a simple hand calc. Computer simulation results are used for final analysis (p. HS24-11).

Variable Frequency Drive Preliminary Analysis 03/06/96
Filename: ECO-HSX.WB2
Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	40 bhp	Exist. Control :	N/C
Motor Eff.:	91.0 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

			INPUT HORSEPOWER				HORSEPOWER * HOURS			
Oper Hr/Wk	%Oper Hours	%Flow Req'd	N/C	DMPR	VIV	VFD	N/C	DMPR	VIV	VFD
104.0	0.62	100%	40.00	40.00	40.00	40.00	216,914	216,914	216,914	216,914
0.0	0.00	90%	40.00	38.80	34.00	29.16	0	0	0	0
0.0	0.00	80%	40.00	38.00	28.00	20.48	0	0	0	0
0.0	0.00	70%	40.00	36.00	26.00	13.72	0	0	0	0
0.0	0.00	60%	40.00	34.00	24.00	8.64	0	0	0	0
0.0	0.00	50%	40.00	32.00	22.00	5.00	0	0	0	0
64.0	0.38	40%	40.00	30.00	20.00	2.56	133,486	100,114	66,743	8,543
168.0	1.00				Totals		350,400	317,029	283,657	225,457

	Energy Use	Energy Cost
N/C = No Control	287,251 kWh/Yr	$7,469 /Yr
DMPR = Outlet Damper	259,894 kWh/Yr	$6,757 /Yr
VIV = Vari. Inlet Vane	232,537 kWh/Yr	$6,046 /Yr
VFD = Vari. Freq. Drive	184,825 kWh/Yr	$4,805 /Yr

Annual Savings for: VFD vs N/C

Energy Savings = 102,426 kWh/Year
Cost Savings = $2,663 /Year

Notes:
1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

HS24-3

Variable Frequency Drive Preliminary Analysis 03/06/96

Filename: ECO-HSX.WB2

Application: Fort Gordon Hospital, 4th Floor

Motor bhp :	5 bhp	Exist. Control :	N/C
Motor Eff.:	89.5 %	New Control:	VFD
Oper Hours:	8760 Hours/Year		
Elec. Rate:	$0.026 /kWh		

			INPUT HORSEPOWER				HORSEPOWER * HOURS			
Oper Hr/Wk	%Oper Hours	%Flow Req'd	N/C	DMPR	VIV	VFD	N/C	DMPR	VIV	VFD
104.0	0.62	100%	5.00	5.00	5.00	5.00	27,114	27,114	27,114	27,114
0.0	0.00	90%	5.00	4.85	4.25	3.65	0	0	0	0
0.0	0.00	80%	5.00	4.75	3.50	2.56	0	0	0	0
0.0	0.00	70%	5.00	4.50	3.25	1.71	0	0	0	0
0.0	0.00	60%	5.00	4.25	3.00	1.08	0	0	0	0
0.0	0.00	50%	5.00	4.00	2.75	0.63	0	0	0	0
64.0	0.38	40%	5.00	3.75	2.50	0.32	16,686	12,514	8,343	1,068
168.0	1.00				Totals		43,800	39,629	35,457	28,182

	Energy Use	Energy Cost
N/C = No Control	36,508 kWh/Yr	$949 /Yr
DMPR = Outlet Damper	33,031 kWh/Yr	$859 /Yr
VIV = Vari. Inlet Vane	29,554 kWh/Yr	$768 /Yr
VFD = Vari. Freq. Drive	23,490 kWh/Yr	$611 /Yr

Annual Savings for: VFD vs N/C

Energy Savings = 13,018 kWh/Year

Cost Savings = $338 /Year

Notes:

1. Equation for VFD HP is: HP2 = (Q2/Q1)^3 x HP1
2. Q = volume air flow, cfm

HS 24-4

CONSTRUCTION COST ESTIMATE

Project: ECO-HS24, Scheduling Controls for SF-6 & EF-5
Location: Fort Gordon, GA
Basis: Schematic Design
Building: Eisenhower Army Medical Center

RS&H No.: 694-1331-005
Date: 03/06/96
Estimator: W. T. Todd
Filename: est-hs24.wb2

ITEM DESCRIPTION	QUANTITY No.	QUANTITY Unit	MATERIAL $/Unit	MATERIAL Total	LABOR $/Unit	LABOR Total	TOTAL COST	SOURCE Material	SOURCE Labor
DDC Controls:									
Setback schedule for fans									
Engineering labor	2	Pt		0	49.68	99	99	MMp318	MMp318
Calibration labor	2	Pt		0	49.68	99	99	MMp318	MMp318
Start-up & chkout labor	2	Pt		0	75.18	150	150	MMp318	MMp318
Set VFDs for minimum flo									
Engineering labor	2	Pt		0	49.68	99	99	MMp318	MMp318
Calibration labor	2	Pt		0	49.68	99	99	MMp318	MMp318
Start-up & chkout labor	2	Pt		0	75.18	150	150	MMp318	MMp318
Manual overide inputs									
Engineering labor	2	Pt		0	49.68	99	99	MMp318	MMp318
Calibration labor	2	Pt		0	49.68	99	99	MMp318	MMp318
Start-up & chkout labor	2	Pt		0	75.18	150	150	MMp318	MMp318
Hand/Off/Auto switch	1	Ea	57	57	38	38	95	MEp195	MEp195
Wire, copper, 600 V, #12	6	CLF	5.9	35	21.5	129	164	MEp144	MEp144
Conduit, 1/2" EMT	200	LF	0.3	60	0.54	108	168	MEp105	MEp105
Subtotal Bare Costs				152		1319	$1,471		
Retrofit Cost Factors			0%	0	0%	0	0	MMp6	MMp6
Subtotal				152		1319	1,471		
City Cost Index (Aug. GA)			0%	0	-46%	-607	(607)	MMp533	MMp533
Subtotal				152		712	864		
OH & Profit Markups			10%	15	53%	377	392	MMp7	MMp475
Subtotal				167		1089	1,256		
Sales Taxes			6.0%	10		NA	10	MMp476	
Subtotal				177		1089	1,266		
Contingency			10%	18	10%	109	127	MMp6	MMp6
Total Construction Cost				195		1198	1,393		
Design Fee				NA	6.0%	84	84		
SIOH				NA	6.0%	84	84		
Total Project Cost				195		1366	$1,561		

LEGEND:
MEp### 1996 Means Electrical Cost Data, page ###.
MMp### 1996 Means Mechanical Cost Data, page ###.

HS 24-5

MIL-HDBK-1191
15 OCTOBER 1991

MILITARY HANDBOOK

DEPARTMENT OF DEFENSE

MEDICAL AND DENTAL TREATMENT FACILITIES

DESIGN AND CONSTRUCTION CRITERIA

AMSC N/A

AREA FACR

DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

HS 24-6

APPENDIX A
ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

ROOM CODE	ROOM NAME	ARCHITECTURAL FINISHES FLOOR	BASE	WALL	CEILING	C'LG HT	DOORS SIZES	ACOUSTICAL NOISE LEVEL IN RM	STC	FLR LD PSF kPa	ELECTRICAL ILL fc	EMERG POWER
OPST1	OUTPAT STRESS TESTING	VCT	R	GWP	ACT1	9'-0" 2750mm	3'-6" 1050mm	35-40	50	60 2.9	50	***
OPSW1	OPTICAL SVC WORK AREA	VCT	R	GWP	ACT1	8'-0" 2400mm	3'-0" 900mm	30-35	40	60 2.9	100	***
OPTM1	OUTPAT TREADMILL ROOM	VCT	R	GWP	ACT1	9'-0" 2750mm	3'-6" 1050mm	35-40	50	60 2.9	50	***
OPVC1	OUTPAT VECTORCARDIO	VCT	R	GWP	ACT1	8'-0" 2400mm	3'-0" 900mm	30-35	40	60 2.9	50	***
OPVL1	OUTPAT VASCULAR LAB	SV	R	GWL	ACT1	8'-0" 2400mm	3'-0" 900mm	30-35	40	60 2.9	50G 100	***
ORCM1	OR CARDIAC MONITORING	SV	IV	GWL	ACT1	10'-0" 3000mm	4'-0" 1200mm	30-35	40	60 2.9	200 M;E	LB;RA
CS1	OR CYSTOSCOPIC SURGERY	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	30-35	45	60 2.9	200 M;E	LB;RA
ORCT1	OR CARDIOTHORACIC SURG	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	30-35	45	60 2.9	200 M;E	LB;RA
ORCW1	OR CLEAN WORK	ET/ SV	CT/ IV	CT/ GWL	GWL	9'-0" 2750mm	3'-0" 900mm	30-35	45	60 2.9	100 M	L;R
ORDA1	OR DECONTAMINATION	CT/ SV	CT/ IV	CT/ GWL	GWL	9'-0" 2730mm	3'-0" 900mm	30-35	45	60 2.9	30	L;R
OREC1	OR EQUIPMENT CLEANUP	VCT/ SV	R/ IV	CT/ GWL	GWL	9'-0" 2750mm	3'-6" 1050mm	30-35	45	60 2.9	30	L;R
ORGS1	OR GENERAL SURGERY	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	30-35	45	60 2.9	200 M;E	LB;RA
ORHL1	OR HEART LUNG PUMP	ET/ SV	CT/ IV	CT/ GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	***	***	60 2.9	20	LS
ORNE1	OR NEUROSURG EQ STOR	SV	IV	GWL	GWL	10'-0" 3000mm	4'-0" 1200mm	***	***	125 6.0	20	LS

APPENDIX A
ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

L GASES Oxygen MV-Med Vac MA-Med Air NO-Nitrous Oxide Nitrogen GA-Gas DA-Dental Air OE-Oral Evac Lab Air PA-Process Air LV-Lab Vac.	NOTES	INTERIOR MECHANICAL DESIGN CONDITIONS 1 AIR BAL	2 AIR CHG	3 MIN OA	4 TEMP SUM	TEMP WIN	5 REL HUM	6 FILTRATION PRE	FIN	7 EXH	NOTES
1MV 1MA	3	0	4	2	78F 26C	70F 21C	***	25%	***	***	
--		0	4	1	78F 26C	68F 20C	***	25%	***	***	
1MV 1MA	3	0	4	2	78F 26C	70F 21C	***	25%	***	***	
1MV 1MA	3	0	4	2	78F 26C	68F 20C	***	25%	***	***	
1MV 1MA	3	-	4	2	78F 26C	70F 21C	***	25%	***	***	
4MV 2MA	3	0	6	2	78F 24C	70F 20C	***	25%	90%	***	
3MV 1MA 1NO	5	++	15	5	68-76F 20-24C		50-60	25%	90%		8 21
3MV 4MA 2NO 2NI	5,7	++	15	5	68-76F 20-24C		50-60	25%	99.97%		8 21
		+	6	2	75F 24C	—	***	25%	90%	***	
1MV 1MA 1NI	10	--	10	2.5	75F 24C	—	***	25%	90%	YES	17
1MV 1MA 1NI	10	+	6	2	75F 24C	—	***	25%	***	YES	
MV 4MA 2NO 2NI	5,7	++	15	5	68-76F 20-24C		50-60	25%	90%		8 21
		++	15	5	68-76F 20-24C		50-60	25%	99.97%		8 21
		+	6	1.5	75F 24C	—	***	25%	90%	***	

APPENDIX A
ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

INTERIOR MECHANICAL DESIGN CONDITIONS
FOR SPECIFIC AREAS, MEDICAL AND DENTAL TREATMENT FACILITIES (continued):

Relative Humidity (RH). This is the relative humidity to be maintained in a space as part of the designed conditions. The humidity may vary from 30 percent to 60 percent except where other design values are given or where there is no requirement for humidity control. Specific summer RH control is not required except for those areas provided under specific notes. Winter RH control is not required except as provided under notes.

6. Filtration. Up to three filter types may be required. The Orthopedic Operating Room requires a 25 percent prefilter, a 90 percent intermediate filter, and a 99.97 percent final filter. The values for the first two filters (see Appendix A) are by the atmospheric dust spot efficiency test. The atmospheric dust spot efficiencies are the minimum average and are based on ASHRAE Standard 52-76. The third filter where required is a HEPA filter which uses the DOP (Dy-Octyl Phthalate, or bis(2-ethylhexyl phthalate) test method. The DOP test efficiency is based on MIL-STD 282. All filters should be installed to prevent leakage between the filter segments and between the filter and its supporting frame.

7. Exhaust Outside. This column lists areas that require 100% exhaust directly to the outside.

8. Air supply shall be 15 air changes per hour unless a higher rate is required to meet cooling requirement and may be totally exhausted when the room is in use. The option as whether to utilize recirculated air during an operation is left to the discretion of the individual Military Departments. Should recirculated air be utilized the minimum outside air requirements would apply. During period of non-use, either (1) 75% of the air may be recirculated or (2) the air volume may be reduced to 3 air changes per hour, while maintaining the required air balance. All systems shall, if cost effective, use exhaust air energy recovery to precondition the incoming outside air.

9. Room exhaust directly over patient stations.

10. For negative isolation, room shall be negative to anteroom and positive to toilet. For positive isolation, room shall be positive to both anteroom and toilet. Anteroom shall be negative to corridor at all times. For isolation room used for patients with a high susceptability to infection from leukemia, burns, bone marrow transplant, organ transplant, or Acquired Immunodeficiency Syndrome, HEPA should be used on air supply system.

11. Exhaust all to outside applicable to process only.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: HS24
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-HS24 SURGICAL SUITE SUPPLY AIR RESET
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 06-30-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 1400.		
B. SIOH	$ 84.		
C. DESIGN COST	$ 84.		
D. TOTAL COST (1A+1B+1C)	$ 1568.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1568.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	738.	$ 5624.	13.68	$ 76930.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	1984.	$ 5357.	17.25	$ 92405.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		2722.	$ 10980.		$ 169335.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 10980.

5. SIMPLE PAYBACK PERIOD (1G/4) .14 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 169335.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 107.99
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 32.19 %

HS24-10

```
****************************************************************************
****************************************************************************
**                                                                        **
**              T R A C E   6 0 0   A N A L Y S I S                       **
**                                                                        **
**              by  C.D.S. MARKETING                                      **
**                                                                        **
****************************************************************************
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EISENHOWER ARMY MEDICAL CENTER
AUGUSTA, GA
SAVANNAH DISTRICT CORPS OF ENGINEERS
REYNOLDS, SMITH & HILLS
SCHEDULE OR AHU

ECO # HS24 Reset Surgical Suite Supply Air

ENERGY SAVINGS

ELC (kwh)	NGAS (therms)
22,118,931	622,460
21,902,632	602,620
216,299	19,840
738 MBTU	1984 MBTU

Weather File Code:	AUGUSTA	
Location:		
Latitude:	33.0	(deg)
Longitude:	82.0	(deg)
Time Zone:	5	
Elevation:	143	(ft)
Barometric Pressure:	29.8	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	95	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	23	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0756	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.1094	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,883.6	(Btu-min./hr/cuft)
Enthalpy Factor:	4.5387	(Lb-min./hr/cuft)

Design Simulation Period: July To July
System Simulation Period: January To December
Cooling Load Methodology: CEC-DOE2/Exact TFM method with CEC\DOE 2.1c constraints

Time/Date Program was Run: 22:21:39 6/26/96
Dataset Name: SSFSCH .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

---------------------------------- M O N T H L Y   E N E R G Y   C O N S U M P T I O N ----------------------------------

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	1,534,644	2,727	73,603	1,961	188
Feb	1,361,771	2,724	69,495	1,760	188
March	1,671,263	2,818	58,066	2,122	183
April	1,786,361	2,967	44,747	2,381	164
May	1,956,230	3,359	40,719	2,821	157
June	2,152,261	3,629	35,426	3,524	152
July	2,256,475	3,624	37,535	3,765	154
Aug	2,238,842	3,649	37,508	3,744	155
Sept	2,009,003	3,491	38,731	3,040	157
Oct	1,724,218	2,895	50,823	2,120	169
Nov	1,614,096	2,851	53,252	1,976	179
Dec	1,597,469	2,755	62,715	1,949	186
Total	21,902,632	3,649	602,620	31,164	188

Building Energy Consumption = 184,311 (Btu/Sq Ft/Year)   Floor Area = 732,541 (Sq Ft)
Source Energy Consumption = 392,766 (Btu/Sq Ft/Year)

HS24-12

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

-------------------------------------- U T I L I T Y   P E A K   C H E C K S U M S ------------------------------------

Utility ELECTRIC DEMAND

Peak Value 3,648.6 (kW)
Yearly Time of Peak 18 (hr) 8 (mo)

Hour 18 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	758.0	20.77
2	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS	600.6	16.46
4	EQ1307	PACKAGED TERMINAL AIR CONDITIONER	26.8	0.73
5	EQ1120L	AIR-CLD RECIPROCATING > 22 TONS	63.5	1.74
Sub Total			1,448.9	39.71
Heating Equipment				
1	EQ2002	GAS FIRED STEAM BOILER	56.0	1.53
Sub Total			56.0	1.53
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	102.3	2.80
2		SUMMATION OF FAN ELECTRICAL DEMAND	102.1	2.80
3		SUMMATION OF FAN ELECTRICAL DEMAND	82.8	2.27
4		SUMMATION OF FAN ELECTRICAL DEMAND	115.9	3.18
5		SUMMATION OF FAN ELECTRICAL DEMAND	21.5	0.59
6		SUMMATION OF FAN ELECTRICAL DEMAND	12.8	0.35
7		SUMMATION OF FAN ELECTRICAL DEMAND	117.4	3.22
8		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	0.04
9		SUMMATION OF FAN ELECTRICAL DEMAND	8.4	0.23
10		SUMMATION OF FAN ELECTRICAL DEMAND	76.0	2.08
Sub Total			640.6	17.56
Sub Total			0.0	0.00
Miscellaneous				
Lights			732.6	20.08
Base Utilities			0.0	0.00
Misc Equipment			770.6	21.12
Sub Total			1,503.1	41.20
Grand Total			3,648.6	100.00

HS 24-13

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 1

-- CALIFORNIA TITLE 24 COMPLIANCE REPORT --

Weather Name .... AUGUSTA
Gross Conditioned Floor Area (sqft)...... 732,541
ACM Multiplier 1.025

-------------------------------------- E N E R G Y   U S E   S U M M A R Y --------------------------------------

	ELEC (kWh/yr)	GAS (kBtu/yr)	WATER (1000 gal)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	141,955.8	33,323,140.0	376.4	25.0	36,530,620.0	51.1
Primary Cooling						
Compressor	2,690,901.3	0.0	0.0	6.8	27,554,892.0	38.6
Tower/Cond Fans	537,923.1	0.0	30,483.0	1.4	5,508,345.5	7.7
Condenser Pump	1,017,137.0	0.0	0.0	2.6	10,415,507.0	14.6
Other Accessories	815,767.1	0.0	0.0	2.1	8,353,474.0	11.7
Auxiliary						
Supply Fans	5,378,677.0	0.0	0.0	13.6	55,077,780.0	77.1
Circulation Pumps	676,739.2	0.0	0.0	1.7	6,929,826.0	9.7
Base Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	6,055,416.0	0.0	0.0	15.3	62,007,604.0	86.8
Lighting	5,344,352.5	0.0	0.0	13.5	54,726,296.0	74.7
Receptacle	5,299,176.5	0.0	0.0	13.4	54,263,692.0	74.1
Domestic Hot Water	0.0	26,938,838.0	304.3	20.0	28,356,672.0	38.7
Cogeneration	0.0	0.0	0.0	0.0	0.0	0.0
Totals	21,902,628.0	60,261,976.0	31,163.7	100.0	287717088.0	397.9

HS24-14

01 Card - Job Information

Project: EISENHOWER ARMY MEDICAL CENTER
Location: AUGUSTA, GA
Client: SAVANNAH DISTRICT CORPS OF ENGINEERS
Program User: REYNOLDS, SMITH & HILLS
Comments: SCHEDULE OR AHU

Card 08 - Climatic Information

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
AUGUSTA								

Card 09 - Load Simulation Periods

1st Month Cooling Simulation	Last Month Cooling Simulation	Peak Cooling Load Hr	1st Month Summer Period	Last Month Summer Period	1st Month Daylight Savings	Last Month Daylight Savings
JUL	JUL					

Card 10 - Load Simulation Parameters

Cooling Load Method	Heating Load Method	Ventilation Method	Airflow Input Units	Airflow Output Units	Room Circulation Rate	Put Wall RA Load to Room
CEC-DOE2	CEC-DOE2					

Card 11 - Energy Simulation Parameters

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
JAN	DEC	ZONE		2001	

Load Section Alternative #1

Card 19- Load Alternative -

Number	Description
1	BASELINE

HS 24-15

Card 25 -- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
534	1										
M610	1			10	1.04	0.9	3	3			
612	1										
614	1										
620	1										
622	1										
630	1										
632	1										
634	1										
710	1										
712	1										
714	1										
720	1										
722	1										
724	1										
M900	1			20	1.04	1.		3			
902	1										
904	1										
906	1										

Card 26 -- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
M100	A-P8HPD	A-L8HPD	AVAIL	OFF		AVAIL	AVAIL	AVAIL	AVAIL	
160	AVAIL	AVAIL								
170	AVAIL	AVAIL								
180	AVAIL	AVAIL								
190	NONE	NONE	NONE	NONE		NONE	NONE			
M210	AVAIL	AVAIL	AVAIL	AVAIL		AVAIL	AVAIL	AVAIL	AVAIL	
240	NONE	NONE	NONE	NONE		NONE	NONE			
M300	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
302						A-MODSKF			A-MODSKF	
330	A-P8HPD	A-L8HPD			A-ORSCH					
332	A-P8HPD	A-L8HPD			A-ORSCH					
334	A-P8HPD	A-L8HPD			A-ORSCH					
350	NONE	NONE	NONE	NONE		NONE	NONE			
M510	AVAIL	AVAIL	AVAIL	OFF		AVAIL	AVAIL		AVAIL	
M610	A-P8HPD	A-L8HPD	AVAIL	AVAIL		AVAIL	AVAIL		AVAIL	
800	NONE	NONE	NONE	NONE		NONE	NONE			
810	NONE	NONE	NONE	NONE		NONE	NONE			

SCHEDULES FANS MINIMUMS
OR only

HS24-16

Card 65-- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	11																

Card 67-- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
2	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						
3	EQ2002	1	40	HP	15000	MBH	80.0	PCTEFF						

Card 69--------------------- Fan Equipment Parameters -------------------------

System Set Number	Cooling Fan	Heating Fan	Return Fan	Exhaust Fan	Auxiliary Supply	Room Exhaust	Optional Ventilation
1	EQ4001		EQ4004			SAMPLE-F	
2	EQ4001		EQ4004			SAMPLE-F	
3	EQ4001					SAMPLE-F	
4	EQ4001		EQ4004			SAMPLE-F	
5	EQ4001					SAMPLE-F	
6	EQ4280					SAMPLE-F	
7	EQ4001		EQ4004			SAMPLE-F	
8	EQ4001					SAMPLE-F	
9	EQ4001					SAMPLE-F	
10	EQ4001					SAMPLE-F	
11	EQ4000					EQ4000	

VSD on OR fan

Card 70------------------- Fan Equipment KW Overrides ----------------------

System Set Number	-----MAIN SYSTEM----- Cool Fan KW	Heat Fan KW	Ret Fan KW	Exh Fan KW	--OTHER SYSTEM-- Aux Sup KW	Room Exh KW	Opt Vent KW	----DEMAND LIMIT PRIORITY--- Cool Fan	Heat Fan	Aux Fan	Room Exh Fan	Opt Vent Fan
1	80		25									
2	80		25									
3	80											
4	100		13									
5	17											
6	33											
7	100		13									
8												
9												
10	16					60						
11												

Utility Description Reference Table

```
Schedules:
     A-L8HPD  LIGHTS 8HR/DA
     A-MODSKF  KIT FAN MOD SCH
     A-ORSCH  OR FAN SCHEDULE
     A-P8HPD  PEOPLE 8HR/DA
     AVAIL  AVAILABLE (100%)
     BLGBASE2  HOSPITAL BLG TEMPLATE HOT WATER SCHEDULE
     CL_76  COOLING TSTAT - CONST 76F
     HOTRLGT  HOTEL ROOMS LIGHTS
     HT_75  HEATING TSTAT - CONST 75F
     NONE  ANY PROJECT
     OFF  ALWAYS OFF
System:
     FC  FAN COIL
     FPVAV  FAN POWERED VAV
     PTAC  PACKAGED TERMINAL AIR COND.
     UV  UNIT VENTILATOR
     VRH  VARIABLE VOLUME REHEAT
Equipment:
     Cooling:
          EQ1001L   2-STG CENTRIFUGAL CHILLER >550 TONS
          EQ1120L  AIR-CLD RECIPROCATING > 22 TONS
          EQ1307  PACKAGED TERMINAL AIR CONDITIONER
          THRMCHHE  TRANE DIRECT FIRED ABSORBER, 1.07 COP
     Heating:
          EQ2002  GAS FIRED STEAM BOILER
     Fan:
          EQ4000  PREVENTS CONSUMPTION OF FAN ENERGY
          EQ4001  AIR FOIL CENTRIFUGAL - CONSTANT VOLUME
          EQ4004  AXIAL FLOW - CONSTANT VOLUME (MODEL Q)
          EQ4280  AIR FOIL FAN W\VARIABLE SPEED DRIVE
          SAMPLE-F  SAMPLE GENERIC FAN
          Tower:
               EQ5100  COOLING TOWER FANS
       Misc:
          EQ5003  CHILLED WATER PUMP-VAV(SAME AS EQ5007)
```

Schedule Name: A-ORSCH
Project: OR FAN SCHEDULE for min. position
Location: EISENHOWER AMC
Client:
Program User:
Comments:

Starting Month: JAN Ending Month: DEC
Starting Day Type: DSGN Ending Day Type: WKDY

Hour	Util Percent
0	40
6	100
17	40
24	

Starting Month: JAN Ending Month: DEC
Starting Day Type: SAT Ending Day Type: SUN

Hour	Util Percent
0	40
24	

RS&H.

SUBJECT FORT GORDON - EAMC
HEAT PIPE FOR KITCHEN
DESIGNER W. TODD
CHECKER

AEP NO 694-1331-005
SHEET ____ OF ____
DATE 3-6-96
DATE

ECO - K15 HEAT RECLAIM SYSTEM FOR EXHAUST HEAT

Information from design drawings:

Make-up air unit supplies 34,400 cfm

EF-7 (Range Hood Exhaust) flow is 35,600 cfm

Assumptions:

1) Exhaust air temperature is 90 °F, 50% RH
2) Make-up air is only heated when the OAT is below 55 °F
3) The kitchen hoods operate from 4 am to 8 pm, 16 hr/day, 7 days per week
4) The heating/boiler system efficiency = 0.65
5) Supply air heat recovery factor = 0.6 (from Figure 9, page K15-11.

Heating Energy Savings:

The equations used and heating energy recovery calculations are shown on page K15-4.

Energy recovered = 1709.3 MBtu/YR

Natural Gas savings = 1709.3 ÷ 0.65 = 2630 MBtu/YR

Nat. Gas Cost savings = $2630 \frac{MBtu}{YR} \times \$2.70/MBtu = \$7100/YR$

RS&H.

SUBJECT FORT GORDON - EAMC
HEAT PIPE FOR KITCHEN
DESIGNER W. TODD
CHECKER

AEP NO 694-1268-005
SHEET ____ OF ____
DATE 3-6-96
DATE

ECO - K15 (continued)

Fan Energy Increase:

Using Figure 10 on page K15-11, and a 5 row coil with 500 fpm face velocity gives a static pressure drop of about 1.0" H_2O.

The correction factor Table 5, page K15-9, at 80 °F and 50% RH is about 1.3.

Increased pressure = 1.0" H_2O × 1.3 = 1.3" H_2O

Fan energy increase ⇒ $BHP = \dfrac{cfm \times SP}{6356 \times eff}$

Assume the fan efficiency is ~ 0.60

cfm = 34400 + 35600 = 70 000 cfm

$$BHP = \frac{70\,000 \times 1.3}{6356 \times 0.60} = 23.9 \text{ BHP increase}$$

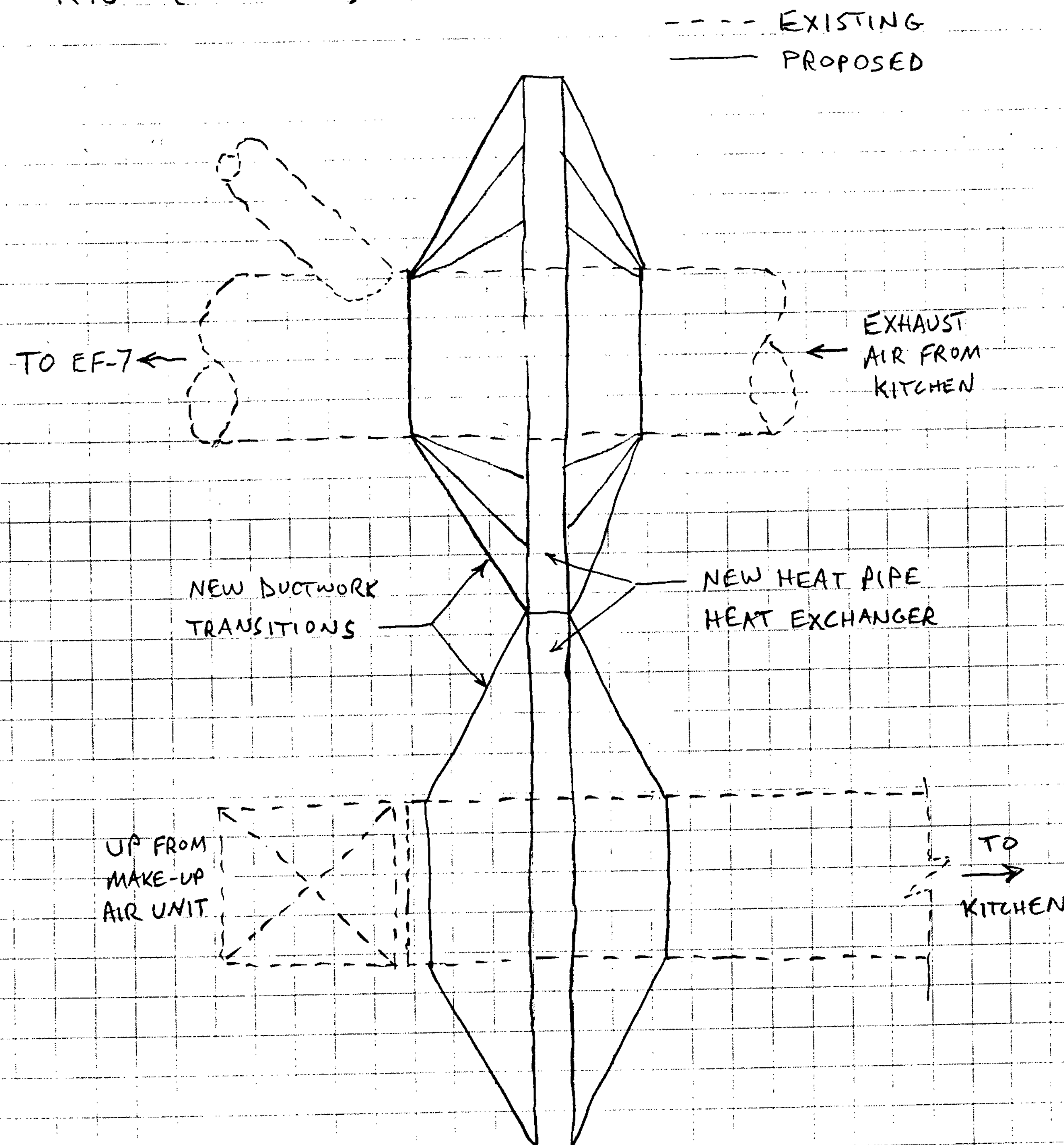
Assuming the motor efficiencies are about 0.90
Energy increase = 23.9 BHP × 0.746 kw/hp ÷ 0.9 = 19.8 kw

$$19.8\ kw \times 16\,\frac{HR}{day} \times 365\,\frac{day}{YR} \times 3413\,\frac{Btu}{KWH} \times \frac{MBtu}{10^6\ Btu} = \text{Elec. Increase}$$

Elec. Increase = (395 MBtu/YR)

$$\text{Electric Cost} = 395\,\frac{MBtu}{YR} \times \$7.64/MBtu = (\$3018/YR)$$

ECO - K15 (Continued)



MAU NAMEPLATE : 32000 cfm, 2.5" SP, 20 hp motor

$$\text{New hp} = \frac{32000 \times (2.5 + 1.3)}{6356 \times 0.6} = 32 \text{ BHP} \Rightarrow 40 \text{ hp motor}$$

Heat Pipe Energy Recovery System 03/01/96
Filename: ECO-K15.WB2
Project: Kitchen Hood Exhaust System
Location: Fort Gordon, GA

Calculation Data:

Supply (make-up) air flow (Scfm):	34400 cfm
Exhaust air flow (Ecfm):	35600 cfm
Heat recovery factor (R):	0.60
Exhaust air temperature (Te):	90 °F
Operating hours from 12M to 8am:	4 Hours
Operating hours from 8am to 4pm:	8 Hours
Operating hours from 4pm to 12M:	4 Hours

OAT Range (°F)		Average OAT (°F)	Hours per Year 0-8	8-16	16-24	Total Hr/Yr	Operating Hr/Yr	Tsl (°F)	Energy Recovered Btu/Hr	MBtu/Yr
50	54	52	248	198	241	687	443	74.8	847,066	374.8
45	49	47	246	149	217	612	381	72.8	958,522	364.7
40	44	42	235	112	181	528	320	70.8	1,069,978	342.4
35	39	37	205	64	127	396	230	68.8	1,181,434	271.7
30	34	32	160	29	73	262	146	66.8	1,292,890	188.1
25	29	27	105	10	29	144	77	64.8	1,404,346	108.1
20	24	22	45	3	9	57	30	62.8	1,515,802	45.5
15	19	17	14	0	1	15	8	60.8	1,627,258	12.2
10	14	12	2	0	0	2	1	58.8	1,738,714	1.7
5	9	7	0	0	0	0	0	56.8	1,850,170	0.0
Totals			1260	565	878	2703	1634			1,709.3

Equations:

M = Mass flow ratio = larger cfm / smaller cfm 1.03

Rs = Supply air heat recovery factor = R = 0.60

Tsl = Make-up supply air temp leaving ht ex = Tse + (Rs x (Te - Tse))

Tse = Make-up supply air temp entering ht ex = average outside air temp.

Energy recovered, Btu/Hr = 1.08 x Scfm x (Tsl - Tse)

Energy recovered, MBtu/Yr = Btu/Hr x Oper Hr/Yr / 1000000

Assumptions:

Heat pipe has 5 row coil and 500 fpm face velocity.
Exhaust air conditions are: 90°F and 50% RH.
Make-up air is heated when OAT is lower than 55°F.
The kitchen exhaust hoods operate from 4am to 8pm.

KI5-5

AUGUSTA/BUSH FIELD GEORGIA

Temperature Range	NOVEMBER Obsn Hour Gp 01 to 08	NOVEMBER Obsn Hour Gp 09 to 16	NOVEMBER Obsn Hour Gp 17 to 24	NOVEMBER Total Obsn	NOVEMBER MCWB	DECEMBER Obsn Hour Gp 01 to 08	DECEMBER Obsn Hour Gp 09 to 16	DECEMBER Obsn Hour Gp 17 to 24	DECEMBER Total Obsn	DECEMBER MCWB	JANUARY Obsn Hour Gp 01 to 08	JANUARY Obsn Hour Gp 09 to 16	JANUARY Obsn Hour Gp 17 to 24	JANUARY Total Obsn	JANUARY MCWB
105/109															
100/104															
95/99															
90/94		0		0	71										
85/89		2	0	2	70										
80/84		6	1	7	67		0		0	69		0		0	67
75/79		19	2	21	64		5	0	5	66		3	1	4	65
70/74	1	33	11	45	62		12	2	14	62	0	11	3	14	62
65/69	11	41	25	77	60	4	21	9	34	60	4	21	10	35	60
60/64	22	38	33	93	56	11	31	19	61	56	9	25	20	54	56
55/59	22	36	34	92	52	17	34	28	79	52	17	35	22	74	51
50/54	27	35	39	101	47	20	41	36	97	47	22	39	31	92	47
45/49	43	20	36	99	44	31	39	38	108	43	25	35	43	103	43
40/44	35	7	28	70	39	38	32	41	111	38	35	35	44	114	38
35/39	33	3	19	55	35	36	19	38	93	34	40	26	35	101	34
30/34	28	1	9	38	31	39	9	22	70	30	40	11	23	74	30
25/29	14	0	2	16	26	30	3	10	43	26	31	5	12	48	25
20/24	3		0	3	22	16	1	4	21	21	18	1	4	23	21
15/19	0			0	18	6	0	1	7	17	6	0	0	6	17
10/14						1	0		1	12	0			0	12
5/9						0			0	7					

Temperature Range	FEBRUARY Obsn Hour Gp 01 to 08	FEBRUARY Obsn Hour Gp 09 to 16	FEBRUARY Obsn Hour Gp 17 to 24	FEBRUARY Total Obsn	FEBRUARY MCWB	MARCH Obsn Hour Gp 01 to 08	MARCH Obsn Hour Gp 09 to 16	MARCH Obsn Hour Gp 17 to 24	MARCH Total Obsn	MARCH MCWB	APRIL Obsn Hour Gp 01 to 08	APRIL Obsn Hour Gp 09 to 16	APRIL Obsn Hour Gp 17 to 24	APRIL Total Obsn	APRIL MCWB
105/109															
100/104															
95/99															
90/94												1	0	1	73
85/89							1	0	1	68		14	3	17	68
80/84		1	0	1	67		8	3	11	66		34	13	47	66
75/79		9	2	11	64		17	7	24	63	1	43	22	66	64
70/74	0	16	7	23	61	3	28	16	47	60	7	44	36	87	62
65/69	5	24	14	43	58	10	37	26	73	58	27	42	51	120	60
60/64	10	30	25	65	55	20	41	40	101	55	53	32	44	129	57
55/59	23	33	31	87	51	32	41	44	117	51	50	21	32	103	53
50/54	25	36	38	99	47	37	31	40	108	47	38	8	21	67	48
45/49	34	30	37	101	43	42	22	32	96	43	27	2	12	41	44
40/44	35	24	31	90	39	42	13	23	78	39	24	0	5	29	40
35/39	34	12	21	67	34	37	4	10	51	34	11		1	12	36
30/34	27	5	12	44	30	18	3	6	27	30	2			2	32
25/29	22	2	4	28	25	7	0	1	8	26					
20/24	7	1	1	9	20	1			1	21					
15/19	2	0	0	2	16										
10/14	1	0		1	11										
5/9															

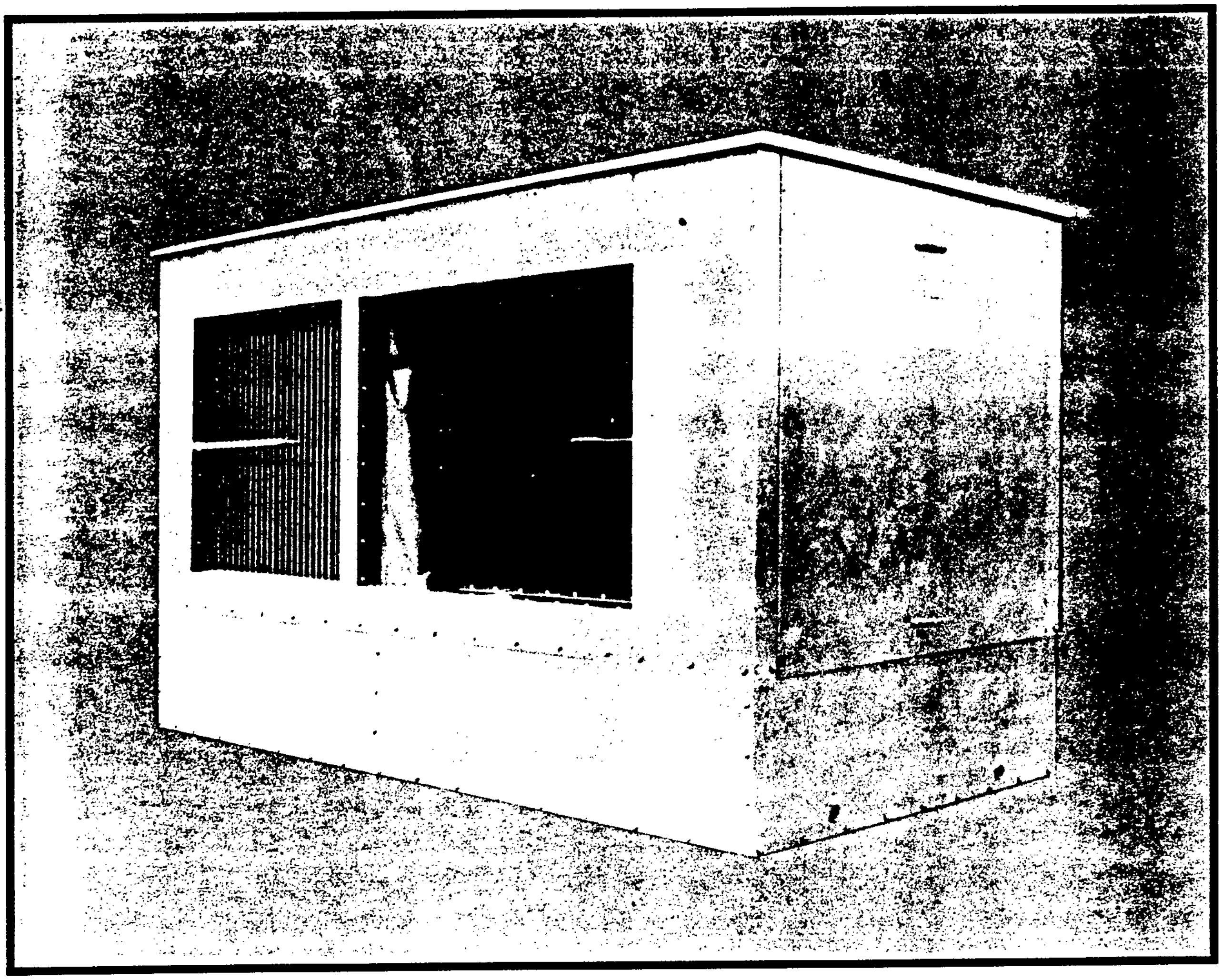
Temperature Range	ANNUAL TOTAL Obsn Hour Gp 01 to 08	ANNUAL TOTAL Obsn Hour Gp 09 to 16	ANNUAL TOTAL Obsn Hour Gp 17 to 24	ANNUAL TOTAL Total Obsn	ANNUAL TOTAL MCWB
105/109		0	0	0	74
100/104		6	0	6	77
95/99		62	12	74	76
90/94	0	228	65	293	75
85/89	4	359	133	496	74
80/84	33	372	232	637	72
75/79	203	323	377	903	70
70/74	494	273	386	1153	67
65/69	363	267	302	932	62
60/64	300	241	277	818	57
55/59	265	221	254	740	52
50/54	248	198	241	687	48
45/49	246	149	217	612	43
40/44	235	112	181	528	39
35/39	205	64	127	396	34
30/34	160	29	73	262	30
25/29	105	10	29	144	26
20/24	45	3	9	57	21
15/19	14	0	1	15	17
10/14	2	0		2	12
5/9	0			0	7

QDT

Bulletin QHV-3
May 1989

Supercedes Bulletin QHV-2
May 1988

HVAC AIR-TO-AIR THERMAL RECOVERY UNITS



- **REDUCES ENERGY COSTS OF VENTILATION AIR**
- **AVAILABLE WITH OPTIONAL AUTOMATIC TEMPERATURE CONTROL**
- **OPTIONAL INDIRECT EVAPORATIVE COOLING MAXIMIZES SUMMER SAVINGS**

KI5-6

MODELS, SPECIFICATIONS AND DIMENSIONS

Two Thermal Recovery Unit models are offered: TRU-120 and TRU-125. The TRU-120 is a compact heat exchanger which utilizes 5/8″ O.D. heat pipes. It offers reduced pressure drops in comparison to the TRU-125 and generally is more cost effective. The TRU-125 incorporates 1″ O.D. heat pipes and is recommended for larger airflow applications. It is available in larger sizes than the TRU-120.

TABLE 1 — TRU SPECIFICATIONS

MODELS AVAILABLE	TRU-120, TRU-125
Fins/Inch	14
Rows Available	3, 4, 5, 6, 7 or 8*
Nominal Tubing O.D.	5/8″ (TRU-120) or 1″ (TRU-125)
Tubing Material	Aluminum Alloy 3003-H14
Fin Design	Corrugated, Cont. Plate
Fin Material	Aluminum Alloy 7072-0
Partition Thickness	0.090″
Partition Material	Aluminum Alloy 5052-H32
Casing Thickness	14 Gauge
Casing Material	Galvanized Steel
End Cover Thickness	20 Gauge
End Cover Material	Galvanized Steel

*8 row not available for TRU-125

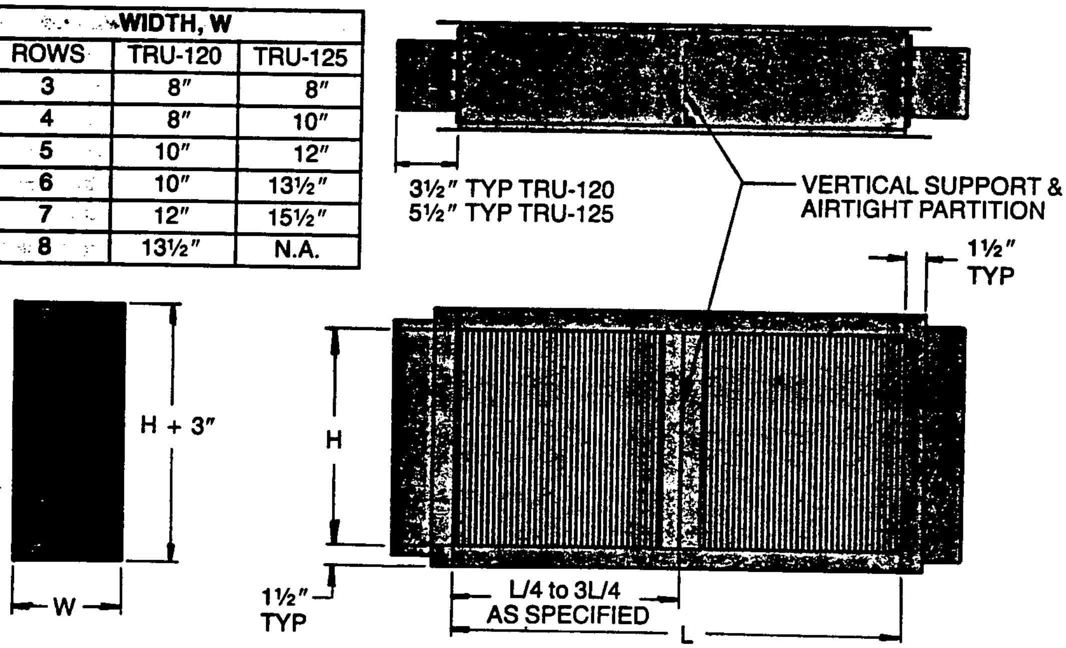
Unit Designation Example:

TRU-125 - 27 - 60 - 5 - 14 - AC - 33

- 33 — exhaust length in inches
- AC — type
- 14 — fins/inch
- 5 — rows
- 60 — face length in inches
- 27 — face height in inches
- TRU-125 — model number

FIGURE 4 — TRU DIMENSIONS

	WIDTH, W	
ROWS	TRU-120	TRU-125
3	8″	8″
4	8″	10″
5	10″	12″
6	10″	13½″
7	12″	15½″
8	13½″	N.A.



NOTES: (1) Due to a policy of continuous product improvement, the manufacturer reserves the right to make changes without notice.

(2) Other fin spacings, fin design, and materials of construction are available. Contact us with your special requirements.

KJS-7

TABLE 2 — TRU-120 FACE AREAS AND WEIGHTS

DIMENSION L	DIMENSION H 12″ FA	12″ WT	18″ FA	18″ WT	24″ FA	24″ WT	30″ FA	30″ WT	36″ FA	36″ WT	42″ FA	42″ WT	48″ FA	48″ WT	54″ FA	54″ WT
24″	2.0	78	3.0	102												
36″	3.0	104	4.5	138	6.0	172	7.5	206	9.0	240						
48″	4.0	131	6.0	174	8.0	217	10.0	260	12.0	303	14.0	346	16.0	390		
60″	5.0	159	7.5	211	10.0	263	12.5	315	15.0	367	17.5	419	20.0	472	22.5	524
72″	6.0	186	9.0	247	12.0	308	15.0	270	18.0	431	21.0	492	24.0	554	27.0	615
84″			10.5	283	14.0	354	17.5	424	21.0	495	24.5	565	28.0	636	31.5	706
96″			12.0	319	16.0	399	20.0	479	24.0	558	28.0	638	32.0	718	36.0	797
108″			13.5	356	18.0	444	22.5	533	27.0	622	31.5	711	36.0	800	40.5	887
120″					20.0	490	25.0	588	30.0	686	35.0	784	40.0	882	45.0	980
132″							27.5	642	33.0	750	38.5	857	44.0	964	49.5	1071
144″							30.0	697	36.0	813	42.0	930	48.0	1046	54.0	1162

TABLE 2 — TRU-120 (cont.)

DIMENSION L	DIMENSION H 60″ FA	60″ WT	66″ FA	66″ WT	72″ FA	72″ WT
60″	25.0	576				
72″	30.0	676	33.0	737	36.0	798
84″	35.0	777	38.5	847	42.0	917
96″	40.0	878	44.0	957	48.0	1036
108″	45.0	974	49.5	1063	54.0	1151
120″	50.0	1075	55.0	1172	60.0	1270
132″	55.0	1175	60.5	1282	66.0	1389
144″	60.0	1276	66.0	1392	72.0	1508

TABLE 3
WEIGHT CORRECTION FACTOR FOR ROWS, WCF

ROWS	TRU-120	TRU-125
3	0.61	0.62
4	0.74	0.81
5	0.87	1.00
6	1.00	1.19
7	1.13	1.38
8	1.26	N.A.

To Calculate Unit Weight:
Weight (lb) = WT x WCF

TABLE 4 — TRU-125 FACE AREAS AND WEIGHTS

DIMENSION L	DIMENSION H 13.5″ FA	13.5″ WT	20.3″ FA	20.3″ WT	27″ FA	27″ WT	33.8″ FA	33.8″ WT	40.5″ FA	40.5″ WT	47.3″ FA	47.3″ WT	54″ FA	54″ WT	60.8″ FA	60.8″ WT
24″	2.3	104	3.4	143												
36″	3.4	143	5.1	197	6.8	252	8.5	306								
48″	4.5	182	6.8	252	9.0	321	11.3	391	13.5	461	15.8	531				
60″	5.6	221	8.5	306	11.3	391	14.1	476	16.9	561	19.7	646	22.5	731		
72″	6.8	260	10.2	361	13.5	461	16.9	561	20.3	661	23.7	762	27.0	861	30.4	961
84″			11.8	415	15.8	530	19.7	646	23.6	761	27.6	877	31.5	992	35.4	1107
96″			13.5	470	18.0	600	22.5	731	27.0	861	31.5	993	36.0	1123	40.5	1253
108″			15.2	525	20.3	669	25.4	816	30.4	961	35.5	1108	40.5	1253	45.6	1399
120″					22.5	739	28.2	902	33.8	1062	39.4	1224	45.0	1384	50.6	1545
132″					24.8	809	31.0	987	37.1	1162	43.4	1339	49.5	1515	55.7	1691
144″					27.0	878	33.8	1072	40.5	1262	47.3	1455	54.0	1645	60.8	1837
156″					29.3	948	36.6	1157	43.9	1362	51.2	1571	58.5	1776	65.8	1983
168″							39.4	1242	47.3	1462	55.2	1686	63.0	1907	70.9	2129
180″							42.3	1327	50.6	1562	59.1	1802	67.5	2038	75.9	2275
192″							45.1	1412	54.0	1663	63.1	1917	72.0	2168	81.0	2421
204″							47.8	1495	57.4	1763	66.9	2031	76.5	2299	86.1	2567
216″							50.6	1580	60.8	1863	70.9	2146	81.0	2430	91.1	2713
228″							53.4	1664	64.1	1963	74.8	2262	85.5	2560	96.2	2859
240″							56.3	1749	67.5	2063	78.8	2377	90.0	2691	101.3	3005

KI5-8

UNIT SELECTION PROCEDURE

TERMS AND DEFINITIONS

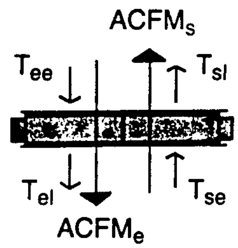


FIGURE 5

T_{se}	= Supply air entering temperature (°F)
T_{sl}	= Supply air leaving temperature (°F)
T_{ee}	= Exhaust air entering temperature (°F)
T_{el}	= Exhaust air leaving temperature (°F)
T_{ft}	= Supply air entering temperature below which frost formation occurs on the unit; frost threshold temperature
ACFM	= Airflow rate at actual conditions (ft³/min)
AFV	= Face velocity at actual conditions (ft/min)
CH	= Full load cooling hours (hr)
DD	= Degree Days, base 65 (°F-day)
FA	= Total unit face area (sq ft)
H	= Unit face height (inches)
M	= Mass flow ratio
Q	= Energy recovered (Btu/hr)
R_a	= Recovery factor for smaller airflow
R_b	= Recovery factor for larger airflow
R_s	= Recovery factor for supply air, $\dfrac{T_{sl} - T_{se}}{T_{ee} - T_{se}}$
R_e	= Recovery factor for exhaust air, $\dfrac{T_{ee} - T_{el}}{T_{ee} - T_{se}}$
Z	= Heat exchanger capacity figure of merit
ΔP	= Static pressure drop (inches W.G.)
Subscript$_e$	= Exhaust air
Subscript$_s$	= Supply air

CALCULATION PROCEDURE

① Determine approximate total unit face area required using supply and exhaust airflows with design AFV (Recommended AFV range is 350 to 700 ft/min).

$$FA_{approx} = \frac{ACFM_s + ACFM_e}{AFV}$$

② Taking approximate FA from Step 1, select nearest size unit from Table 2 or 4 and use actual FA to recalculate AFV.

If the airflow partition is located to maintain equal velocities and static pressure drops:

$$AFV_s = AFV_e = \frac{ACFM_s + ACFM_e}{FA} = AFV_{average}$$

(Note: the allowable limits of partition location are from 25 to 75% of unit face length from one end).

If the partition is placed in the center:

$$AFV_s = \frac{ACFM_s}{FA/2} \qquad AFV_e = \frac{ACFM_e}{FA/2}$$

$$AFV_{average} = \frac{AFV_s + AFV_e}{2}$$

(QDT recommends that the partition be placed in the center whenever the two airflows are within 20% of each other).

③ Calculate the Mass flow ratio, M:

$$M = \frac{\text{ACFM (Larger airflow)}}{\text{ACFM (Smaller airflow)}}$$

When airflows are equal, M = 1.

④ Using rows, $AFV_{average}$ and M, obtain Recovery Factor for smaller airflow, R_a, from Figure 6 or 9. Calculate R_b for larger airflow:

$$R_b = \frac{R_a}{M}$$

⑤ Determine recovery factors for supply and exhaust airflows.

(a) When supply airflow is smaller than exhaust airflow: $R_s = R_a$, $R_e = R_b$

(b) When supply airflow is larger than exhaust airflow: $R_s = R_b$, $R_e = R_a$

(c) When airflows are equal (M = 1): $R_s = R_a = R_b = R_e$

⑥ Using exhaust entering temperature and relative humidity, and the ratio ($ACFM_s/ACFM_e$), obtain the frost threshold temperature, T_{ft}, from Figure 8 or 11. (Applies to winter calculation only.)
Note: If an Integrated Tilt Package is used for frost protection, and the frost threshold is greater than the winter supply entering temperature, then the resulting supply side recovery factor at the winter design point will be approximately

$$(R_s)\text{ FROST PROTECTED} = R_s\left(\frac{T_{ee} - T_{ft}}{T_{ee} - T_{se}}\right)$$

⑦ Calculate supply air leaving temperature:

$$T_{sl} = T_{se} + [R_s \times (T_{ee} - T_{se})]$$

⑧ Obtain supply air pressure drop, ΔP_s, using rows and AFV_s in Figure 7 or 10. For exhaust air, first obtain exhaust air dry pressure drop, ΔP, using rows and AFV_e in Figure 7 or 10. Then, obtain exhaust air pressure drop correction factor, PCF, from Table 5 below. Compute actual exhaust air pressure drop from:
$\Delta P_e = \Delta P \times PCF$.

TABLE 5 — EXHAUST AIR PRESSURE DROP CORRECTION FACTOR, PCF

	Exhaust Relative Humidity						
T_{ee}	20%	30%	40%	50%	60%	80%	100%
65°F	1.00	1.00	1.13	1.23	1.31	1.42	1.50
70°F	1.00	1.06	1.18	1.27	1.33	1.43	1.50
75°F	1.00	1.11	1.21	1.29	1.35	1.44	1.50
80°F	1.01	1.14	1.24	1.31	1.37	1.45	1.50

Note: If unit is coated, increase calculated values of ΔP_s and ΔP_e by 1.20.

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(9) Calculate Energy Recovered, Q:

$$Q = 1.08 \times ACFM_S \times (T_{sl} - T_{se})$$

(10) Calculate installation position using heat exchanger capacity figure of merit, Ƶ, rows and unit face height, H. (For stacked units use total face height of all units).

$$Ƶ = \frac{12 \times Q}{rows \times H}$$

If Ƶ is less than or equal to 8,200 for TRU-120, or 24,700 for TRU-125, exchanger can be installed level.

If Ƶ is greater than the factors above, exchanger must be tilted to provide adequate capacity. If only winter operation is desired, unit may be installed at fixed tilt. However, if both summer and winter operation are desired, an Integrated Tilt Package must be used to provide proper tilt in the two seasons. Refer to Integrated Tilt Package section for further discussion and explanation.

(11) Calculate savings:

A. Equipment savings:

Step 9 reflects the equipment energy savings. To obtain equipment costs savings in dollars, multiply results of Step 9 by alternate equipment cost rate. (Estimates for these rates are given below.

WINTER:
A reasonable estimate of heating equipment cost rate is $3000/million Btu/hr.

SUMMER:

$$\text{tons saved} = \frac{Q}{12{,}000}$$

A reasonable estimate of cooling equipment cost rate is $800/ton.

B. Operating savings:

WINTER:
Operating energy savings =

$$1.08 \times ACFM_S \times R_S \times DD \times 24\text{ hr/day} \times \frac{\text{operating hrs/wk}}{168} = \text{(Btu/season)}$$

SUMMER:
Operating energy savings =

$$\text{tons saved} \times 1.4\text{ kw/ton} \times CH \times \frac{\text{operating hrs/wk}}{168} = \text{(kwh/season)}$$

To obtain operating cost savings in dollars/season, multiply the above results by fuel cost rate in dollars/energy unit.

Note: The above formulas provide good, quick estimates of the energy savings. For detailed calculations consult the nearest QDT sales representative or the factory. Computer diskettes for selection and economic analysis are also available.

EXAMPLE:

Design conditions:

$ACFM_s = 10{,}000$
$ACFM_e = 9{,}100$

Operating hrs/wk = 120

Winter: T_{ee} = 70°F/20% RH
T_{se} = 5°F
DD = 6000
fuel = nat. gas @ $5.50/$10^6$ Btu

Summer: T_{ee} = 75°F
T_{se} = 95°F
CH = 800
fuel = electricity @ $0.07/kwh

Selection:

Winter

1. $FA_{approx} = \frac{10{,}000 + 9{,}100}{500} = 38.2$ sq. ft.
2. Select TRU-120 with H = 42″, L = 132″: FA = 38.5 sq. ft.
   With center partition:
   $AFV_s = \frac{10{,}000}{38.5/2} = 519$ $AFV_e = \frac{9{,}100}{38.5/2} = 473$
   $AFV_{average} = \frac{519 + 473}{2} = 496$
3. $M = \frac{10{,}000}{9{,}100} = 1.10$
4. Selecting 6 row deep unit with 14 fins/inch:
   $R_a = 0.63$
   $R_b = 0.63/1.10 = 0.573$
5. Condition (b) applies:
   $R_s = R_b = 0.573$
   $R_e = R_a = 0.630$
6. T_{ft} = 3°F, no frost protection required.
7. $T_{sl} = 5 + [0.573 \times (70 - 5] = 42.2$°F
8. ΔP_s = 0.75″ W.G.
   ΔP = 0.65″ W.G.; PCF = 1.00
   $\Delta P_e = 0.65 \times 1.00 = 0.87$″ W.G.
9. $Q = 1.08 \times 10000 \times (42.2 - 5) = 401{,}760$ Btu/hr
10. $Ƶ = \frac{12 \times 401{,}760}{6 \times 42} = 19{,}130$

    Heat exchanger must be tilted to provide adequate capacity. Since summer operation is desired, an Integrated Tilt Package is necessary.
11. (A) Equipment cost savings = $\frac{\$3000}{10^6} \times 401{,}760 = \$1{,}205$

    (B) Operating energy savings =
    $1.08 \times 10000 \times 0.573 \times 6000 \times 24 \times (120/168)$
    = 636.5 million Btu/season
    Operating cost savings =
    636.5 million $\times \frac{\$5.50}{\text{million}}$ = $3,501/season

Summer

1. **thru 4.** Calculated in winter conditions
5. Condition (b) applies: $R_s = R_b = 0.573$
   $R_e = R_a = 0.630$
6. Does not apply
7. $T_{sl} = 95 + [0.573 \times (75 - 95)] = 83.5$°F
8. Calculated in winter conditions
9. $Q = 1.08 \times 10000 \times (83.5 - 95)$
   $= -124{,}200$ Btu/hr (cooling)
10. Does not apply
11. (A) Equipment energy savings = $\frac{124{,}200}{12{,}000}$ = 10.4 tons

    Equipment cost savings = 10.4 × 800 = $8,320

    (B) Operating energy savings = 10.4 × 1.4 × 800 × (120/168) = 8,320 kwh/season
    Operating cost savings = 8,320 × $0.07 = $582/season

KJS-10

FIGURE 9 — TRU-125 RECOVERY PERFORMANCE

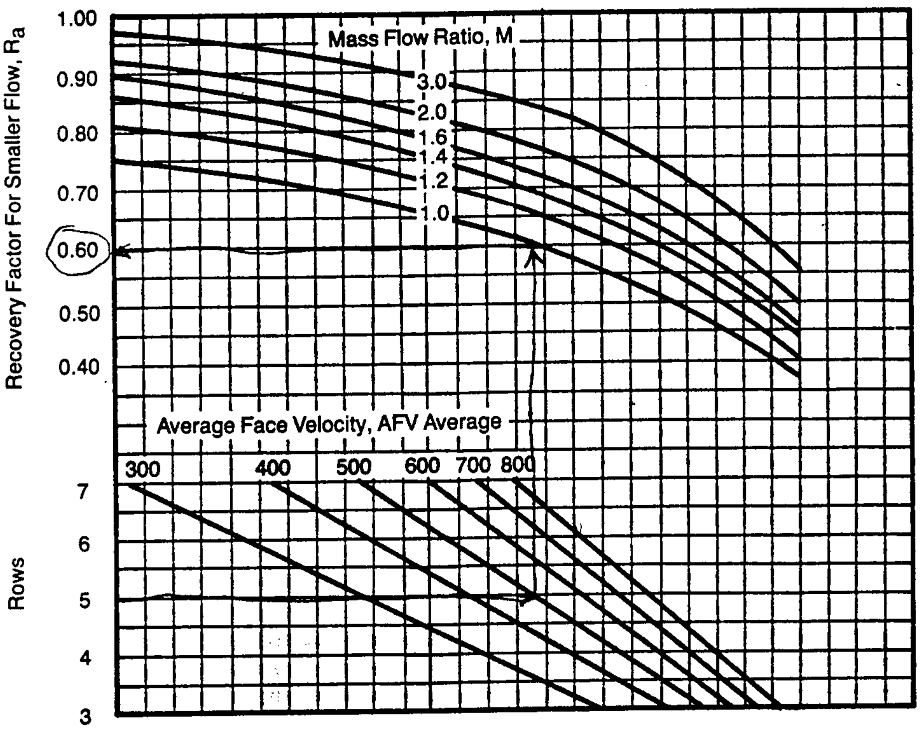


FIGURE 10 — TRU-125 PRESSURE DROP

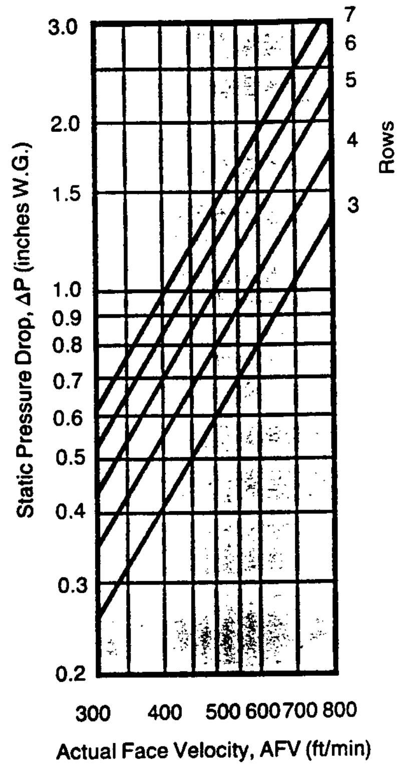
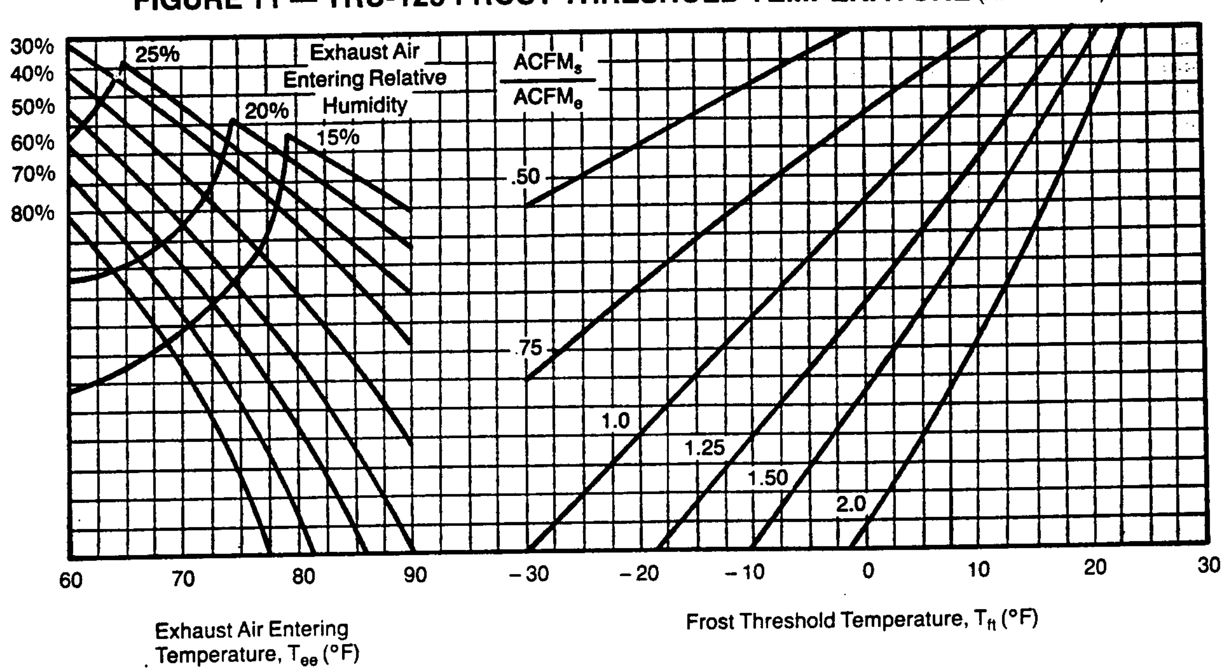


FIGURE 11 — TRU-125 FROST THRESHOLD TEMPERATURE (ANY ROWS)



KI5-11

CONSTRUCTION COST ESTIMATE

Project:	ECO-K15, Heat Pipe Heat Recovery for Kitchen	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	03/07/96
Basis:	Schematic Design	Estimator:	W. T. Todd
Building:	Eisenhower Army Medical Center	Filename:	est-k15.wb2

ITEM DESCRIPTION	QUANTITY		MATERIAL		LABOR		TOTAL COST	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total		Material	Labor
Air to air heat recovery for									
commercial kitchen exh									
Heat pipe exchanger	34.4	kcfm	1675	57620	108	3715	61,335	MMp229	MMp229
Water wash system	1	Ea	2880	2880	185	185	3,065	Est. 5%	Est. 5%
Ductwork, 22 Ga, Galvan.	500	lb	1.82	910	6.85	3425	4,335	MMp294	MMp294
Remove exist. 20 hp moto	1	Ea		0	90	90	90		MEp199
Motor, 40 hp, 1800 rpm	1	Ea	1375	1375	117	117	1,492	MEp199	MEp199
Subtotal Bare Costs				62785		7532	$70,317		
Retrofit Cost Factors			0%	0	5%	377	377	MMp6	MMp6
Subtotal				62785		7909	70,694		
City Cost Index (Aug. GA)			0%	0	-46%	-3638	(3,638)	MMp533	MMp533
Subtotal				62785		4271	67,056		
OH & Profit Markups			10%	6279	53%	2264	8,543	MMp7	MMp475
Subtotal				69064		6535	75,599		
Sales Taxes			6.0%	4144		NA	4,144	MMp476	
Subtotal				73208		6535	79,743		
Contingency			10%	7321	10%	654	7,975	MMp6	MMp6
Total Construction Cost				80529		7189	87,718		
Design Fee				NA	6.0%	5263	5,263		
SIOH				NA	6.0%	5263	5,263		
Total Project Cost				80529		17715	$98,244		

LEGEND:

MEp### 1996 Means Electrical Cost Data, page ###.

MMp### 1996 Means Mechanical Cost Data, page ###.

R157-100 Sheet Metal Calculator (Weight in Lb./Ft. of Length)

Gauge	26	24	22	20	18	16	Gauge	26	24	22	20	18	16
Wt.-Lb./S.F.	.906	1.156	1.406	1.656	2.156	2.656	Wt.-Lb./S.F.	.906	1.156	1.406	1.656	2.156	2.656
SMACNA Max. Dimension – Long Side		30"	54"	84"	85" Up		SMACNA Max. Dimension – Long Side		30"	54"	84"	85" Up	
Sum-2 sides							Sum-2 Sides						
2	.3	.40	.50	.60	.80	.90	56	9.3	12.0	14.0	16.2	21.3	25.2
3	.5	.65	.80	.90	1.1	1.4	57	9.5	12.3	14.3	16.5	21.7	25.7
4	.7	.85	1.0	1.2	1.5	1.8	58	9.7	12.5	14.5	16.8	22.0	26.1
5	.8	1.1	1.3	1.5	1.9	2.3	59	9.8	12.7	14.8	17.1	22.4	26.6
6	1.0	1.3	1.5	1.7	2.3	2.7	60	10.0	12.9	15.0	17.4	22.8	27.0
7	1.2	1.5	1.8	2.0	2.7	3.2	61	10.2	13.1	15.3	17.7	23.2	27.5
8	1.3	1.7	2.0	2.3	3.0	3.6	62	10.3	13.3	15.5	18.0	23.6	27.9
9	1.5	1.9	2.3	2.6	3.4	4.1	63	10.5	13.5	15.8	18.3	24.0	28.4
10	1.7	2.2	2.5	2.9	3.8	4.5	64	10.7	13.7	16.0	18.6	24.3	28.8
11	1.8	2.4	2.8	3.2	4.2	5.0	65	10.8	13.9	16.3	18.9	24.7	29.3
12	2.0	2.6	3.0	3.5	4.6	5.4	66	11.0	14.1	16.5	19.1	25.1	29.7
13	2.2	2.8	3.3	3.8	4.9	5.9	67	11.2	14.3	16.8	19.4	25.5	30.2
14	2.3	3.0	3.5	4.1	5.3	6.3	68	11.3	14.6	17.0	19.7	25.8	30.6
15	2.5	3.2	3.8	4.4	5.7	6.8	69	11.5	14.8	17.3	20.0	26.2	31.1
16	2.7	3.4	4.0	4.6	6.1	7.2	70	11.7	15.0	17.5	20.3	26.6	31.5
17	2.8	3.7	4.3	4.9	6.5	7.7	71	11.8	15.2	17.8	20.6	27.0	32.0
18	3.0	3.9	4.5	5.2	6.8	8.1	72	12.0	15.4	18.0	20.9	27.4	32.4
19	3.2	4.1	4.8	5.5	7.2	8.6	73	12.2	15.6	18.3	21.2	27.7	32.9
20	3.3	4.3	5.0	5.8	7.6	9.0	74	12.3	15.8	18.5	21.5	28.1	33.3
21	3.5	4.5	5.3	6.1	8.0	9.5	75	12.5	16.1	18.8	21.8	28.5	33.8
22	3.7	4.7	5.5	6.4	8.4	9.9	76	12.7	16.3	19.0	22.0	28.9	34.2
23	3.8	5.0	5.8	6.7	8.7	10.4	77	12.8	16.5	19.3	22.3	29.3	34.7
24	4.0	5.2	6.0	7.0	9.1	10.8	78	13.0	16.7	19.5	22.6	29.6	35.1
25	4.2	5.4	6.3	7.3	9.5	11.3	79	13.2	16.9	19.8	22.9	30.0	35.6
26	4.3	5.6	6.5	7.5	9.9	11.7	80	13.3	17.1	20.0	23.2	30.4	36.0
27	4.5	5.8	6.8	7.8	10.3	12.2	81	13.5	17.3	20.3	23.5	30.8	36.5
28	4.7	6.0	7.0	8.1	10.6	12.6	82	13.7	17.5	20.5	23.8	31.2	36.9
29	4.8	6.2	7.3	8.4	11.0	13.1	83	13.8	17.8	20.8	24.1	31.5	37.4
30	5.0	6.5	7.5	8.7	11.4	13.5	84	14.0	18.0	21.0	24.4	31.9	37.8
31	5.2	6.7	7.8	9.0	11.8	14.0	85	14.2	18.2	21.3	24.7	32.3	38.3
32	5.3	6.9	8.0	9.3	12.2	14.4	86	14.3	18.4	21.5	24.9	32.7	38.7
33	5.5	7.1	8.3	9.6	12.5	14.9	87	14.5	18.6	21.8	25.2	33.1	39.2
34	5.7	7.3	8.5	9.9	12.9	15.3	88	14.7	18.8	22.0	25.5	33.4	39.6
35	5.8	7.5	8.8	10.2	13.3	15.8	89	14.8	19.0	22.3	25.8	33.8	40.1
36	6.0	7.8	9.0	10.4	13.7	16.2	90	15.0	19.3	22.5	26.1	34.2	40.5
37	6.2	8.0	9.3	10.7	14.1	16.7	91	15.2	19.5	22.8	26.4	34.6	41.0
38	6.3	8.2	9.5	11.0	14.4	17.1	92	15.3	19.7	23.0	26.7	35.0	41.4
39	6.5	8.4	9.8	11.3	14.8	17.6	93	15.5	19.9	23.3	27.0	35.3	41.9
40	6.7	8.6	10.0	11.6	15.2	18.0	94	15.7	20.1	23.5	27.3	35.7	42.3
41	6.8	8.8	10.3	11.9	15.6	18.5	95	15.8	20.3	23.8	27.6	36.1	42.8
42	7.0	9.0	10.5	12.2	16.0	18.9	96	16.0	20.5	24.0	27.8	36.5	43.2
43	7.2	9.2	10.8	12.5	16.3	19.4	97	16.2	20.8	24.3	28.1	36.9	43.7
44	7.3	9.5	11.0	12.8	16.7	19.8	98	16.3	21.0	24.5	28.4	37.2	44.1
45	7.5	9.7	11.3	13.1	17.1	20.3	99	16.5	21.2	24.8	28.7	37.6	44.6
46	7.7	9.9	11.5	13.3	17.5	20.7	100	16.7	21.4	25.0	29.0	38.0	45.0
47	7.8	10.1	11.8	13.6	17.9	21.2	101	16.8	21.6	25.3	29.3	38.4	45.5
48	8.0	10.3	12.0	13.9	18.2	21.6	102	17.0	21.8	25.5	29.6	38.8	45.9
49	8.2	10.5	12.3	14.2	18.6	22.1	103	17.2	22.0	25.8	29.9	39.1	46.4
50	8.3	10.7	12.5	14.5	19.0	22.5	104	17.3	22.3	26.0	30.2	39.5	46.8
51	8.5	11.0	12.8	14.8	19.4	23.0	105	17.5	22.5	26.3	30.5	39.9	47.3
52	8.7	11.2	13.0	15.1	19.8	23.4	106	17.7	22.7	26.5	30.7	40.3	47.7
53	8.8	11.4	13.3	15.4	20.1	23.9	107	17.8	22.9	26.8	31.0	40.7	48.2
54	9.0	11.6	13.5	15.7	20.5	24.3	108	18.0	23.1	27.0	31.3	41.0	48.6
55	9.2	11.8	13.8	16.0	20.9	24.8	109	18.2	23.3	27.3	31.6	41.4	49.1
							110	18.3	23.5	27.5	31.9	41.8	49.5

Example: If duct is 34" x 20" x 15' long, 34" is greater than 30" maximum, for 24 ga. so must be 22 ga. 34" + 20" = 54" going across from 54" find 13.5 lb. per foot. 13.5 x 15' = 202.5 lbs. For S.F. of surface area 202.5 ÷ 1.406 = 144 S.F.

Note: Figures include an allowance for scrap.

KI5-13

R157-040 Recommended Ventilation Air Changes

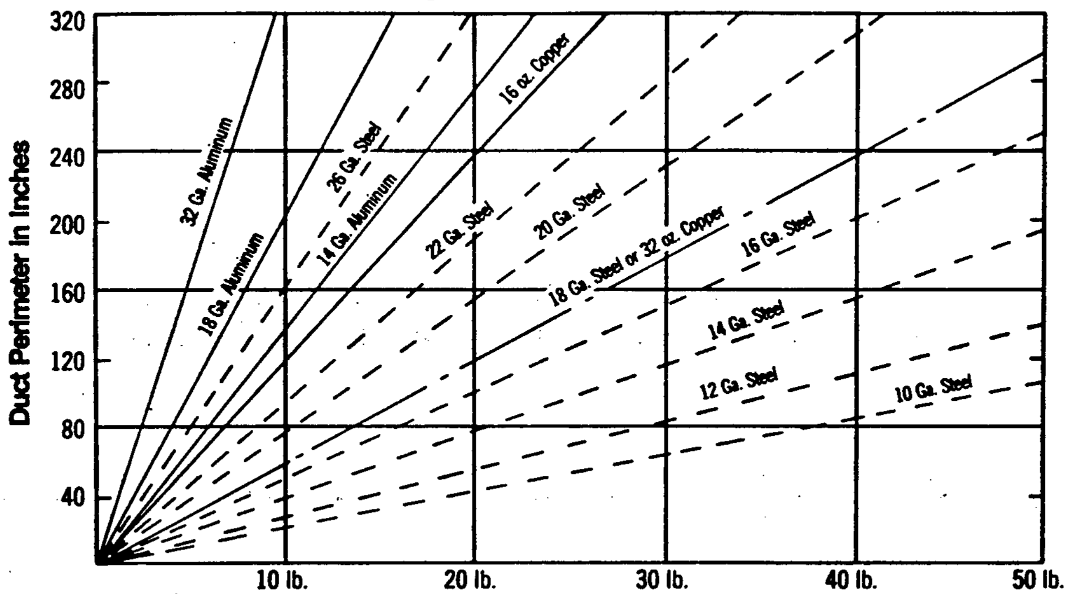
Table below lists range of time in minutes per change for various types of facilities.

Assembly Halls	2-10	Dance Halls	2-10	Laundries	1-3
Auditoriums	2-10	Dining Rooms	3-10	Markets	2-10
Bakeries	2-3	Dry Cleaners	1-5	Offices	2-10
Banks	3-10	Factories	2-5	Pool Rooms	2-5
Bars	2-5	Garages	2-10	Recreation Rooms	2-10
Beauty Parlors	2-5	Generator Rooms	2-5	Sales Rooms	2-10
Boiler Rooms	1-5	Gymnasiums	2-10	Theaters	2-8
Bowling Alleys	2-10	Kitchens-Hospitals	2-5	Toilets	2-5
Churches	5-10	Kitchens-Restaurant	1-3	Transformer Rooms	1-5

CFM air required for changes = Volume of room in cubic feet ÷ Minutes per change.

R157-050 Ductwork

Duct Weight in Pounds per L.F., Straight Runs



Add to the above for fittings; 90° elbow is 3 L.F.; 45° elbow is 2.5 L.F.; offset is 4 L.F.; transition offset is 6 L.F.; square-to-round transition is 4 L.F.; 90° reducing elbow is 5 L.F. For bracing and waste, add 20% to aluminum and copper, 15% to steel.

R157-060 Diffuser Evaluation

CFM = V × An × K where V = Outlet velocity in feet per minute. An = Neck area in square feet and K = Diffuser delivery factor. An undersized diffuser for a desired CFM will produce a high velocity and noise level. When air moves past people at a velocity in excess of 25 FPM, an annoying draft is felt. An oversized diffuser will result in low velocity with poor mixing. Consideration must be given to avoid vertical stratification or horizontal areas of stagnation.

R157-070 Duct Fabrication/Installation

The labor cost for sheet metal duct using lines 157-250-0070 thru 1060 includes both the cost of fabrication and installation of the duct. The split is approximately 40% for fabrication, 60% for installation. It is for this reason that the percentage add for elevated installation is less than the percentage add for prefabricated duct as found starting on line 157-250-1283.

Example: assume a piece of duct cost $100 installed (labor only)

Sheet Metal Fabrication = 40% = $40
Installation = 60% = $60

The add for elevated installation is:

Based on total labor (fabrication & installation) = $100 x 6% = $6.00
Based on installation cost only (Material purchased prefabricated) = $60 x 10% = $6.00

The $6.00 markup (10′ to 15′ high) is the same.

KI5-14

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: KI5
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-KI5 KITCHEN EXHAUST HEAT RECLAIM
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 87700.		
B. SIOH	$ 5262.		
C. DESIGN COST	$ 5262.		
D. TOTAL COST (1A+1B+1C)	$ 98224.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 98224.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	-395.	$ -3010.	13.68	$ -41175.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	2630.	$ 7101.	17.25	$ 122492.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		2235.	$ 4091.		$ 81317.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 4091.

5. SIMPLE PAYBACK PERIOD (1G/4) 24.01 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 81317.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .83
(IF < 1 PROJECT DOES NOT QUALIFY)

KI5-15

RS&H

Telephone Call Confirmation

Project Number 694 1331 005

Local 363-1991 L.D. ______ Placed ______ Rec'd ______ Date 3-7-96

Conversed with Tom Williams of Carrier Corp. - Jax. Rep.

Regarding Heat Pump water heaters

ECO KIT Install heat pump water heater.
Carrier used to make these but ~~[illegible]~~ they have not been in their product line for ~~many~~ many years.

Doucette Industries, Inc 1-800-445-7511
Spoke with Mr. Chuck Becker - they make desuperheaters. Heat pump water heaters are limited to providing small amounts of relatively low temperature water. They are typically used for residential DHW and pool heating.

Distribution:

KIT-1

SUBJECT FORT GORDON - EAMC EFFICIENT EXH. HOODS	AEP NO 694-1331-005
	SHEET ___ OF ___
DESIGNER W. TODD	DATE 3-7-96
CHECKER	DATE

RS&H

ECO - KI8 ENERGY EFFICIENT EXHAUST HOODS - KITCHEN

Energy efficient kitchen exhaust hoods can utilize unheated make-up air. Energy savings are achieved by reduced heating of the kitchen make-up air.

Kitchen Exhaust Hoods:

Make-up Air	Exh. Air	Hood LF	Retrofit
8700 cfm	7700 cfm	30 ft.	Yes
16700	15200	30	Yes
800	700	7	Yes
-0-	4000	8	No - No direct make-up
1400	2000	8	Yes
1000	1400	8	Yes
28600 cfm			

Assumptions:

1) Make-up air is only heated when the OAT is below 55°F.
2) The kitchen exhaust hoods operate from 4am to 8pm, 16 hr/day, 365 days per year.
3) The make-up air is heated to 95°F.

Heating Energy Savings:

Heating energy savings were calulated using bin temperature data for Augusta, GA and a spreadsheet computer program. The calculations and equations used are shown on page KI8-2.

Energy Efficient Exhaust Hoods 03/01/96

Filename: ECO-K18.WB2
Project: Energy Efficient Kitchen Exhaust Hoods
Location: Fort Gordon, GA

Calculation Data:

Supply (make-up) air flow (Scfm):	28600	cfm
Heated make-up air supply temp (Ts):	95	°F
Operating hours from 12M to 8am:	4	Hours
Operating hours from 8am to 4pm:	8	Hours
Operating hours from 4pm to 12M:	4	Hours

OAT Range (°F)		Average OAT (°F)	Hours per Year 0-8	8-16	16-24	Total Hr/Yr	Operating Hr/Yr	Energy Savings Btu/Hr	MBtu/Yr
50	54	52	248	198	241	687	443	1,328,184	587.7
45	49	47	246	149	217	612	381	1,482,624	564.1
40	44	42	235	112	181	528	320	1,637,064	523.9
35	39	37	205	64	127	396	230	1,791,504	412.0
30	34	32	160	29	73	262	146	1,945,944	283.1
25	29	27	105	10	29	144	77	2,100,384	161.7
20	24	22	45	3	9	57	30	2,254,824	67.6
15	19	17	14	0	1	15	8	2,409,264	18.1
10	14	12	2	0	0	2	1	2,563,704	2.6
5	9	7	0	0	0	0	0	2,718,144	0.0
Totals			1260	565	878	2703	1634		2,620.9

Equations:

Tm = Make-up supply air temp = average outside air temp.

Energy savings, Btu/Hr = 1.08 x Scfm x (Ts - Tm)

Energy savings, MBtu/Yr = Btu/Hr x Oper Hr/Yr / 1000000

Assumptions:

Make-up air is only heated when OAT is lower than 55°F.
The kitchen exhaust hoods operate from 4am to 8pm.

RS&H

SUBJECT FORT GORDON - EAMC
EFFICIENT EXH. HOODS
DESIGNER W. TODD
CHECKER

AEP NO 694-1331-005
SHEET ____ OF ____
DATE 3-7-96
DATE

ECO-KI8 (continued)

Heating savings (from page KI8-2) = 2620.9 $\frac{MBtu}{YR}$

Assume a heating/boiler efficiency of 0.65.

Natural Gas Savings = 2620.9 ÷ 0.65 = $\underline{4032 \frac{MBtu}{YR}}$

Nat. Gas Cost Savings = 4032 × \$2.70/MBtu = $\underline{\$10{,}890/\text{year}}$

There are two zones served by the Make-up air unit that still require heating.

Duct mounted electric heating coils will be installed to provide heat to these areas.

Areas to be heated:

Zone A @ 1600 cfm & Zone B @ 4200 cfm

Size Duct Coils: ASHRAE 99% winter design temp. for Augusta, GA is 20 °F

Zone A: $1.08 \times 1600\,\text{cfm} \times (95°F - 20°F) \times \frac{1\,\text{KW}}{3413\,\text{Btu}} = 38 \Rightarrow 40\,\text{KW}$

Zone B: $1.08 \times 4200\,\text{cfm} \times (95-20)°F \times \frac{1\,\text{KW}}{3413\,\text{Btu}} = 99.7 \Rightarrow 100\,\text{KW}$

Electric Energy Increase: Increased electric use was calculated by the same method as the heating energy savings. The calculations and equations are contained on page KI8-4.

Energy Efficient Exhaust Hoods 03/01/96

Filename: ECO-k18a.WB2

Project: Energy Efficient Kitchen Exhaust Hoods

Location: Fort Gordon, GA

Calculation Data:

Supply (make-up) air flow (Scfm):	5800 cfm
Heated make-up air supply temp (Ts):	95 °F
Operating hours from 12M to 8am:	4 Hours
Operating hours from 8am to 4pm:	8 Hours
Operating hours from 4pm to 12M:	4 Hours

OAT		Average	Hours per Year			Total	Operating	Energy Increase	
Range (°F)		OAT (°F)	0-8	8-16	16-24	Hr/Yr	Hr/Yr	kW	kWh/Yr
50	54	52	248	198	241	687	443	79	34,922
45	49	47	246	149	217	612	381	88	33,521
40	44	42	235	112	181	528	320	97	31,127
35	39	37	205	64	127	396	230	106	24,483
30	34	32	160	29	73	262	146	116	16,824
25	29	27	105	10	29	144	77	125	9,610
20	24	22	45	3	9	57	30	134	4,019
15	19	17	14	0	1	15	8	143	1,074
10	14	12	2	0	0	2	1	152	152
5	9	7	0	0	0	0	0	162	0
	Totals		1260	565	878	2703	1634		155,732

Equations:

Tm = Make-up supply air temp = average outside air temp.

Energy Increase, kW = 1.08 x Scfm x (Ts - Tm) / 3413

Energy increase, kWh/Yr = kW x Operating Hr/Yr

Assumptions:

Make-up air is only heated when OAT is lower than 55°F.
The kitchen exhaust hoods operate from 4am to 8pm.

RS&H

SUBJECT FORT GORDON - EAMC
EFFICIENT EXHAUST HOODS
DESIGNER W. TODD
CHECKER

AEP NO 694 1331 005
SHEET OF
DATE 3-7-96
DATE

ECO - KI8 (continued)

Electric Increase (from pg. KI8-4) = 155,732 Kwh/YR

$$= 155732 \frac{\text{Kwh}}{\text{YR}} \times \frac{3413 \text{ Btu}}{\text{Kwh}} \times \frac{1 \text{ mBtu}}{10^6 \text{ Btu}} = (532) \text{ mBtu/YR}$$

$$\text{Electric cost increase} = 532 \frac{\text{mBtu}}{\text{YR}} \times \$7.64/\text{mBtu} = (\$4060)/\text{YR}$$

Net energy cost savings:

Cost savings = \$10890 - \$4060 = \$6830/YR

CONSTRUCTION COST ESTIMATE

Project:	ECO-K18, Energy Efficient Kitchen Exhaust Hoods	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	03/05/96
Basis:	Schematic Design	Estimator:	W. T. Todd
Building:	Eisenhower Army Medical Center	Filename:	est-k18.wb2

ITEM DESCRIPTION	QUANTITY		MATERIAL		LABOR		TOTAL COST	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total		Material	Labor
Remove existing hoods	2.5	ton		0	485	1213	1,213		MMp21
Exhaust hood w/ wash	30	LF	1082.5	32475	91.5	2745	35,220	MMp277	MMp277
Exhaust hood w/ wash	30	LF	1082.5	32475	91.5	2745	35,220	MMp277	MMp277
Exhaust hood w/ wash	7	LF	1082.5	7578	91.5	641	8,219	MMp277	MMp277
Exhaust hood w/ wash	8	LF	1082.5	8660	91.5	732	9,392	MMp277	MMp277
Exhaust hood w/ wash	6	LF	1082.5	6495	91.5	549	7,044	MMp277	MMp277
Electric duct heater	40	kW	60.5	2420	44	1760	4,180	MMp343	MMp343
Electric duct heater	100	kW	60.5	6050	44	4400	10,450	MMp343	MMp343
Fan interlock relay	2	Ea	101	202	29.5	59	261	MMp221	MMp221
Thermostat	2	Ea	284	568	19.05	38	606	MMp221	MMp221
Balance exhaust hoods	5	Ea		0	142.51	713	713		MMp332
Balance MUA fan	1	Ea		0	213.77	214	214		MMp332
Subtotal Bare Costs				96923		15809	$112,732		
Retrofit Cost Factors			0%	0	0%	0	0	MMp6	MMp6
Subtotal				96923		15809	112,732		
City Cost Index (Aug. GA)			0%	0	-46%	-7272	(7,272)	MMp533	MMp533
Subtotal				96923		8537	105,460		
OH & Profit Markups			10%	9692	53%	4525	14,217	MMp7	MMp475
Subtotal				106615		13062	119,677		
Sales Taxes			6.0%	6397		NA	6,397	MMp476	
Subtotal				113012		13062	126,074		
Contingency			10%	11301	10%	1306	12,607	MMp6	MMp6
Total Construction Cost				124313		14368	138,681		
Design Fee				NA	6.0%	8321	8,321		
SIOH				NA	6.0%	8321	8,321		
Total Project Cost				124313		31010	$155,323		

LEGEND:

MEp### 1996 Means Electrical Cost Data, page ###.

MMp### 1996 Means Mechanical Cost Data, page ###.

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: KI8

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)

INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: ECO-KI8 ENERGY EFFICIENT KITCHEN EXHAUST HOODS

FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A

ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 138700.		
B. SIOH	$ 8322.		
C. DESIGN COST	$ 8322.		
D. TOTAL COST (1A+1B+1C)	$ 155344.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 155344.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	-532.	$ -4054.	13.68	$ -55457.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	4032.	$ 10886.	17.25	$ 187790.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		3500.	$ 6833.		$ 132334.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.

(1) DISCOUNT FACTOR (TABLE A) 12.90

(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 6833.

5. SIMPLE PAYBACK PERIOD (1G/4) 22.74 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 132334.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .85

(IF < 1 PROJECT DOES NOT QUALIFY)

RS&H

SUBJECT ______ AEP NO ______
SHEET ____ OF ____
DESIGNER Hutchins DATE 3/11/96
CHECKER ______ DATE ______

ECO # LT 2 Reduce Lighting Levels

Delamp Hallway Light Fixtures (2x4 2L)

Area	#	Area	#	Area	#
1A -	11	2A -	0	3A -	0
1B -	29	2B -	17	3B -	0
1C -	25	2C -	4	3C -	7
1D -	32	2D -	32	3D -	20
1E -	15	2E -	19	3E -	8
1F -	14	2F -	23	3F -	19
1G -	14	2G -	28	3G -	3
1H -	22	2H -	12	3H -	19
1J -	21	2I -	13	3I -	0
1K -	20	2J -	14	3J -	0
1L -	27	2K -	11	3K -	29
	230	2L -	23	3L -	7
		2M -	12	3M -	0
		2N -	11	3N -	0
		2O -	29	3O -	2
		2P -	21	3P -	15
		2Q -	18		129
		2R -	22		
			281		

4A -	15	5A	16	6A		7-13 A	25
4B -	4	5B -	35	6B		7-13 B	42
4C -	15	5C -	16	6C		7-13 C	24
	34		67				91

TOTAL = 230 + 281 + 129 + 34 + 67 + 91 * 8 = 1469 fixtures

Energy savings assuming all are T8's (2L → 1L) (58w → 32w)

$$\frac{1469 * 26w * 8760}{1000} = 334{,}579 \text{ kwh} = 1142 \text{ MBTU/yr.}$$

RS&H

SUBJECT
DESIGNER
CHECKER
AEP NO
SHEET OF
DATE
DATE

Delamping Library (4^{th} FLR)

42 4L Fluorescents

Current light level readings range from 100 to 190

Removing 2 lamps and disconnecting one ballast saves half the fixture energy

Assume they will be converted to T8's (58w - 32w)

$$\text{Savings} = \frac{\frac{26\ \text{watt}}{\text{fixture}} * 42 * \frac{5\ \text{da}}{\text{wk}} * \frac{52\ \text{wk}}{\text{yr}} * \frac{10\ \text{hr}}{\text{da}}}{1000}$$

$$= 2839\ \frac{\text{kwh}}{\text{yr}} = \underline{\underline{10}}\ \frac{\text{MBtu}}{\text{yr}}$$

Switching half of Family Practice Medical Records area lights off save

$$\text{Savings} = \frac{\frac{26\ \text{w}}{\text{fixt}} * 24 * 5 * 52 * 10}{1000} = 1622\ \frac{\text{kwh}}{\text{yr}}$$

$$= \underline{\underline{6}}\ \text{MBtu/yr}$$

Total delamping savings = 1142+10+6= $\underline{\underline{1158}}$ MBtu/yr.

Total fixtures = 1469+42+24=$\underline{\underline{1535}}$

LT 2 - 2

FTGORDON Lumen Method

Reynolds, Smith & Hills, Inc.
4651 Salisbury Road
Jacksonville, FL 32256

EXISTING CONDITIONS
HALLWAY

Lumen Method Computation
Generated by LitePro V2.27E
Provided and supported by USI Lighting, Inc.
Filename: FTGORDON Type: Indoor

Lumen Method Computation

Project name: EAMC Energy Audit	Project #
Prepared for: Savannah District COE	Date: 11-Mar-96
Prepared by: Paul Hutchins	

Area Name : HALLWAY No. Identical Areas = 1
Description: TYPICAL HALLWAY

DIMENSIONS:	(Ft)	REFLECTANCES:	(Dec. %)
Width (E-W) :	8.00	Ceiling :	0.80
Length (N-S) :	56.00	North Wall :	0.50
Ceiling Height :	9.00	East Wall :	0.50
Mounting Height :	9.00	South Wall :	0.50
Workplane Height :	2.50	West Wall :	0.50
Total Area :	448.00	Floor Cavity:	0.50
RCR (Room Ratio) :	4.64		

ENVIRONMENTAL CONDITION: Very Clean # OBSTRUCTIONS: 0

Type F2 : TEST #K10193, COLUMBIA, 2J240-HP, PATTERN-LITE
2'X4' 2L STATIC GRID TROFFER, HOLOPHANE #8224 LESS OVERLAY
LAMPS: (2) F40CW, Lumens= 3050
BALLAST: ESB, WATTS= 90
COEFFICIENT OF UTILIZATION: 55.6%

FACTORS:	....	PLACEMENT:	: ....
Luminaire Dirt :	0.87	Total Number :	7
Lamp Lumen Loss :	0.88	Pattern :	0.0X 8.0
Ballast :	0.95	# Columns/Rows :	1/7
Lamp/ballast :	1.00	Start Column (X) :	4.00
Misc :	1.00	Start Row (Y) :	4.00
>> Total LLF :	0.73		

PERFORMANCE:	....
Ave. Footcandles :	38.51
Watts/Sq. Foot :	1.41

******

Uses IES procedures for Lumen Method. USI is not responsible for light output of lamp/ballast, non-USI products, or design variables not shown.

FTGORDON Lumen Method

Reynolds, Smith & Hills, Inc.
4651 Salisbury Road
Jacksonville, FL 32256

PROPOSED DELAMP TO ONE LAMP PER FIXTURE

Lumen Method Computation
Generated by LitePro V2.27E
Provided and supported by USI Lighting, Inc.
Filename: FTGORDON Type: Indoor

Lumen Method Computation

Project name: EAMC Energy Audit Prepared for: Savannah District COE Prepared by: Paul Hutchins	Project # Date: 11-Mar-96

Area Name : HALLWAY No. Identical Areas = 1
Description: TYPICAL HALLWAY

DIMENSIONS:	(Ft)	REFLECTANCES:	(Dec. %)
Width (E-W) :	8.00	Ceiling :	0.80
Length (N-S) :	56.00	North Wall :	0.50
Ceiling Height :	9.00	East Wall :	0.50
Mounting Height :	9.00	South Wall :	0.50
Workplane Height :	2.50	West Wall :	0.50
Total Area :	448.00	Floor Cavity:	0.50
RCR (Room Ratio) :	4.64		

ENVIRONMENTAL CONDITION: Very Clean # OBSTRUCTIONS: 0

Type F3 : TEST #10083, COLUMBIA, 5PA4*-52-141, 5PA
1X4 1L FLUSH AIRHANDLE TROFFER, LENS- .110" THK PRISMATIC A12
LAMPS: (1) F40WW, Lumens= 3050
BALLAST: ESB, WATTS= 45
COEFFICIENT OF UTILIZATION: 47.3%

FACTORS:	....	PLACEMENT:	: ....
Luminaire Dirt :	0.87	Total Number :	7
Lamp Lumen Loss :	0.88	Pattern :	0.0X 8.0
Ballast :	0.95	# Columns/Rows :	1/7
Lamp/ballast :	1.00	Start Column (X) :	4.00
Misc :	1.00	Start Row (Y) :	4.00
>> Total LLF :	0.73		

PERFORMANCE:	....
Ave. Footcandles :	16.38
Watts/Sq. Foot :	0.70

******

Uses IES procedures for Lumen Method. USI is not responsible for light output of lamp/ballast, non-USI products, or design variables not shown.

CONSTRUCTION COST ESTIMATE

Project:	ECO # LT2-1 Reduce Lighting Levels (Delamp Fixtures)	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/12/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	EST_LT2.XLS

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Delamp Fixture	1535	ea			$3.91	$6,002	$6,002		MEp15
Subtotal Bare Costs				$0		$6,002	$6,002		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$0		$6,002	$6,002		
City Cost Index (Aug. GA)			0%	$0	-46%	($2,761)	($2,761)	MMp533	MMp533
				-		-	-		
Subtotal				$0		$3,241	$3,241		
OH & Profit Markups			10%	$0	53%	$1,718	$1,718	MMp7	MMp475
				-		-	-		
Subtotal				$0		$4,959	$4,959		
Sales Taxes			6.0%	$0		NA	$0	MMp476	
				-		-	-		
Subtotal				$0		$4,959	$4,959		
Contingency			10%	$0	10%	$496	$496	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$0		$5,455	$5,455		
Design Fee				NA	6.0%	$298	$298		
SIOH				NA	6.0%	$298	$298		
				-		-	-		
Total Project Cost				$0		$6,051	$6,051		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: LT2
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT2 REDUCE LIGHTING LEVELS
FISCAL YEAR 1996 DISCRETE PORTION NAME: N/A
ANALYSIS DATE: 03-12-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 5500.			
B. SIOH	$ 330.			
C. DESIGN COST	$ 330.			
D. TOTAL COST (1A+1B+1C)	$ 6160.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.		
F. PUBLIC UTILITY COMPANY REBATE		$ 0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 6160.	

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	1158.	$ 8824.	13.68	$ 120712.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		1158.	$ 8824.		$ 120712.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 8824.

5. SIMPLE PAYBACK PERIOD (1G/4) .70 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 120712.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 19.60
(IF < 1 PROJECT DOES NOT QUALIFY)

RS&H

SUBJECT
DESIGNER Hutchins
CHECKER

AEP NO
SHEET OF
DATE 2/14/96
DATE

ECO LT4 Convert of Energy Efficient Systems

LT4A – Retrofit with T8 Lamps and Ballasts
Screening calc. for conversion of T-12, magnetic ballast to T-8, electronic ballast

2L - T-12 system - 90[1] watts
2L - T-8 system - 60 watts (rapid start type)
Savings 30 "

Annual hrs of opn =
Hallways = 8760 hrs/yr
Offices = 10 hrs/da, 5 da/wk = 2600 hrs/yr
Patient areas = 16 hrs/da, 7 da/wk = 5824 hrs/yr

Savings Per 100 Fixtures

Opn Hrs	kwh	$/yr	MBtu/yr
8760	26,280	$ 683	90
5824	17,472	$ 454	60
2600	7800	$ 203	27

(1) Based on original ballast rating of 92 watts and newer ballasts rated at 86 watts
(2) Average marginal kwh rate = 2.6¢/kwh

CONSTRUCTION COST ESTIMATE

Project:	ECO LT4A Retrofit with T-8 Lamps and Ballasts	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/9/96
Basis:	Schematic Design	Estimator:	P. Hutchins
Building:	Eisenhower Army Medical Center	Filename:	ESTLT4A.XLS

ITEM DESCRIPTION	QUANTITY No.	Unit	MATERIAL/EQUIP $/Unit	Total	LABOR $/Unit	Total	TOTAL COST	SOURCE Material	Labor
Electronic Ballast	100	ea	$ 37.00	$ 3,700	$7.38	$738	$4,438	MEp234	MEp234
T-8 Lamps	200	ea	$ 2.00	$ 400			$400	Dp25,114	
Notes: Lamp replacement labor is included in ballast labor dollars.									
Ballast labor is one-fourth of Means due to economy of scale									
Subtotal Bare Costs				$4,100		$738	$4,838		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$4,100		$738	$4,838		
City Cost Index (Aug. GA)			0%	$0	-46%	($339)	($339)	MMp533	MMp533
				-		-	-		
Subtotal				$4,100		$399	$4,499		
OH & Profit Markups			10%	$410	53%	$211	$621	MMp7	MMp475
				-		-	-		
Subtotal				$4,510		$610	$5,120		
Sales Taxes			6.0%	$271		NA	$271	MMp476	
				-		-	-		
Subtotal				$4,781		$610	$5,391		
Contingency			10%	$478	10%	$61	$539	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$5,259		$671	$5,930		
Design Fee				NA	6.0%	$323	$323		
SIOH				NA	6.0%	$323	$323		
				-		-	-		
Total Project Cost				$5,259		$1,317	$6,576		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###
MEp###	1996 Means Electrical Cost Data, page ###
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LT4-2

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: LT4A
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4A RETROFIT W/ T-8 LAMPS & ELEC BALLASTS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 1 - HALLWAYS
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 5900.		
B. SIOH	$ 354.		
C. DESIGN COST	$ 354.		
D. TOTAL COST (1A+1B+1C)	$ 6608.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 6608.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	90.	$ 686.	13.68	$ 9382.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		90.	$ 686.		$ 9382.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 686.

5. SIMPLE PAYBACK PERIOD (1G/4) 9.64 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 9382.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.42
(IF < 1 PROJECT DOES NOT QUALIFY)

LT4-2a

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: LT4A
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4A RETROFIT W/ T-8 LAMPS & ELEC BALLASTS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 2 - PATIENT ROOMS
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT
A. CONSTRUCTION COST $ 5900.
B. SIOH $ 354.
C. DESIGN COST $ 354.
D. TOTAL COST (1A+1B+1C) $ 6608.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 6608.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	60.	$ 457.	13.68	$ 6254.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		60.	$ 457.		$ 6254.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 457.

5. SIMPLE PAYBACK PERIOD (1G/4) 14.45 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 6254.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .95
(IF < 1 PROJECT DOES NOT QUALIFY)

LT4-26

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: LT4A
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4A RETROFIT W/ T-8 LAMPS & ELEC BALLASTS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 3 - OFFICES
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 5900.			
B. SIOH	$ 354.			
C. DESIGN COST	$ 354.			
D. TOTAL COST (1A+1B+1C)	$ 6608.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 6608.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	27.	$ 206.	13.68	$ 2815.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		27.	$ 206.		$ 2815.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 206.

5. SIMPLE PAYBACK PERIOD (1G/4) 32.12 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2815.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .43
(IF < 1 PROJECT DOES NOT QUALIFY)

LT4-2c

RS&H

SUBJECT

AEP NO

DESIGNER Hutchins

SHEET OF

DATE 2/16/96

CHECKER

DATE

Screening Calculations

LT4B1

Replace 175 watt MV in 4th Floor office with new 2x4 recessed parabolics with 3-T8s and EBs

Lamps / FIXT	Lamp	Fixt watts	# FIXT	lumens / lamp	life	Unit Lamp Cost	Fixt Cost
1	MV-175W	210	4	8600	24,000	$64 (1)	-
3	T8 - 32W	88	4	2900	10,000	2.00 (2)	$125 (3)

Energy Savings

			kwh	cost
MV:	210 * 4 * 2600 hrs/yr ÷ 1000	=	2184	$56.8
T8s	88 * 4 * 2600 ÷ 1000	=	915	23.8
	Savings / yr.	=	1269	$33.0

(1) Grainger, 1995 #386 p. 891

(2) Energy Efficient Lighting, DGSC, 2/94 p 25 & 114

(3) EEL, DGSC, p. 56 & 106 fixture + ballast. Installation ∴ '96 Means Ele. p. 230

SUBJECT

DESIGNER Hutchins

CHECKER

AEP NO

SHEET OF

DATE 2/16/96

DATE

ECO LT4B1 Cont'd

Annual lamp replacement costs:

MV - $\frac{2600}{24,000} * 4l = \frac{0.43 \text{ lamps}}{yr} * \left[\$63.50 + \frac{27.50}{2}\right]$

$= \$33.2/yr$

T8 - $\frac{2600}{20,000} * 12l = \frac{1.56 \text{ lamps}}{yr} * \left[2.00 + \frac{27.50}{2}\right]$

$= \$24.6/yr$

Savings = \$33.2 - 24.6 = \$8.6/yr

Simple Payback: Initial Cost ÷ annual savings

Initial cost = [\$125 + 3 * 2 + 27.50/hr * 1.6 hr] = \$175/fixt.

S.P. = $\frac{175 * 4}{33 + 25} = \frac{\$700}{\$58}$ = 12.1 yrs

(1) Labor costs = \$18/hr * 1.53 = \$27.54/hr

CONSTRUCTION COST ESTIMATE

Project:	ECO #LT4B1 Retrofit MV with T-8 Fixtures	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/5/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTLT4B1.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
2X4 Parabolic Troffer									
with Electronic Ballast	4	ea	$125.00	$500	$44.00	$176	$676	Dp56,106	MEp230
T-8 Lamps	12	ea	$2.00	$24		$0	$24	Dp25,114	
Note: Lamp labor included in fixture labor									
Subtotal Bare Costs				$524		$176	$700		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$524		$176	$700		
City Cost Index (Aug. GA)			0%	$0	-46%	($81)	($81)	MMp533	MMp533
				-		-	-		
Subtotal				$524		$95	$619		
OH & Profit Markups			10%	$52	53%	$50	$102	MMp7	MMp475
				-		-	-		
Subtotal				$576		$145	$721		
Sales Taxes			6.0%	$35		NA	$35	MMp476	
				-		-	-		
Subtotal				$611		$145	$756		
Contingency			10%	$61	10%	$15	$76	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$672		$160	$832		
Design Fee				NA	6.0%	$45	$45		
SIOH				NA	6.0%	$45	$45		
				-		-	-		
Total Project Cost				$672		$250	$922		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: LT4B
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)

INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4B REPLACE MERCURY VAPOR FIXTURES
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 1 - T-8 FIXTURES
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 830.		
B. SIOH	$ 50.		
C. DESIGN COST	$ 50.		
D. TOTAL COST (1A+1B+1C)	$ 930.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 930.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	4.	$ 33.	13.68	$ 448.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		4.	$ 33.		$ 448.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 9.
(1) DISCOUNT FACTOR (TABLE A)	12.90	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 116.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 116.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 42.

5. SIMPLE PAYBACK PERIOD (1G/4) 22.27 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 564.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .61
(IF < 1 PROJECT DOES NOT QUALIFY)

LT4-5a

FTGORDON Lumen Method

Reynolds, Smith & Hills, Inc.
4651 Salisbury Road
Jacksonville, FL 32256

Lumen Method Computation
Generated by LitePro V2.27E
Provided and supported by USI Lighting, Inc.
Filename: FTGORDON Type: Indoor

Lumen Method Computation	
Project name: EAMC Energy Audit Prepared for: Savannah District COE Prepared by: Paul Hutchins	Project # Date: 16-Feb-96

Area Name : 16X16 OFF MH No. Identical Areas = 1
Description: 16x16 OFFICE
Metal Halide Lamps (6)

DIMENSIONS:	(Ft)	REFLECTANCES:	(Dec. %)
Width (E-W) :	16.00	Ceiling :	0.80
Length (N-S) :	16.00	North Wall :	0.50
Ceiling Height :	9.00	East Wall :	0.50
Mounting Height :	9.00	South Wall :	0.50
Workplane Height :	2.50	West Wall :	0.50
Total Area :	256.00	Floor Cavity:	0.20
RCR (Room Ratio) :	4.06		

ENVIRONMENTAL CONDITION: Clean # OBSTRUCTIONS: 0

Type H1 : TEST #B1751A, PRESCOLITE, 90M5-100MHFE-M71, LENSED ROUND VERTICAL
10"DIA.RECESSED(VERT.)DOWNLITE, LENS- FRESNEL W/ GREY REGRESS
LAMPS: (1) M-100/C, Lumens= 8000
BALLAST: STD, WATTS= 118
COEFFICIENT OF UTILIZATION: 45.0%

FACTORS:	....	PLACEMENT:	: ....
Luminaire Dirt :	0.81	Total Number :	6
Lamp Lumen Loss :	0.80	Pattern :	6.0X 6.0
Ballast :	1.00	# Columns/Rows :	3/2
Lamp/ballast :	1.00	Start Column (X) :	2.00
Misc :	1.00	Start Row (Y) :	5.00
>> Total LLF :	0.65		

PERFORMANCE:	....
Ave. Footcandles :	54.68
Watts/Sq. Foot :	2.77

******

Uses IES procedures for Lumen Method. USI is not responsible for light output of lamp/ballast, non-USI products, or design variables not shown.

LT4-6

FTGORDON 16X16 OFF MH Costs

Reynolds, Smith & Hills, Inc.
4651 Salisbury Road
Jacksonville, FL 32256

Area Cost Analysis
Generated by LitePro V2.27E
Provided and supported by USI Lighting, Inc.
Filename: FTGORDON Type: Indoor

Area Cost Analysis

Project name: EAMC Energy Audit	Project #
Prepared for: Savannah District COE	Date: 16-Feb-96
Prepared by: Paul Hutchins	UPD: 2.8W/Sq.Ft

Area Name : 16X16 OFF MH No. Identical Areas = 1
Description: 16x16 OFFICE
Metal Halide Lamps (6)

DIMENSIONS:	(Ft)	REFLECTANCES:	(Dec. %)
Width (E-W) :	16.00	Ceiling :	0.80
Length (N-S) :	16.00	North Wall :	0.50
Ceiling Height :	9.00	East Wall :	0.50
Total Area :	256.00	South Wall :	0.50
RCR (Room Ratio) :	4.06	West Wall :	0.50
		Floor Cavity:	0.20

ENVIRONMENTAL CONDITION: Clean # OBSTRUCTIONS: 0
LUMINAIRES:

Type H1 : TEST #B1751A : TOTAL QUANTITY PER AREA = 6
PRESCOLITE, 90M5-100MHFE-M71, LENSED ROUND VERTICAL
10"DIA.RECESSED(VERT.)DOWNLITE, LENS- FRESNEL W/ GREY REGRESS
LAMPS: (1) M-100/C, Lumens= 8000
BALLAST: STD, WATTS= 118

LT4-7

NAIRE COMPUTATIONAL PARAMETERS:

```
Type H1 : TEST #B1751A  :  Luminaire >> 90M5-100MHFE-M71
              Total Light Loss Factor =  0.65
                   Luminaire Dirt Depreciation =  0.81
                   Lamp Lumen Depreciation     =  0.80
                   Ballast Factor              =  1.00
                   Lamp/ballast Factor         =  1.00
                   Misc Light Loss Factor      =  1.00
              Lamp Lumen Ratio Factor =  1.00
                   Original Lamp Rating        =  8000
                   Actual Lumens Used          =  8000
              TOTAL CANDLEPOWER MULTIPLIER=       0.65
```

RS&H	SUBJECT
	DESIGNER
	CHECKER
	AEP NO
	SHEET OF
	DATE
	DATE

ECO LT4B2

Replace 175-watt mercury vapors in 4th offices with 100-watt metal halides

Lighting calculations show that six lamps would be required to maintain 50 fc lighting levels

Energy Savings =

		kwh	$
MV =	4 * 210 * 2600 ÷ 1000 =	2184	$56.8
MH =	6 * 118 * 2600 ÷ 1000 =	1841	$ 47.9
	Annual savings =	343	$ 8.9

Replacement cost saving

$$MV = 2600/24{,}000 * 4\ell * \left[\$64 + \frac{27.50}{2}\right]^{(1)} = \$33.7$$

$$MH = 2600/10{,}000 * 6\ell * [60 + 27.5/2]^{(2)} = \$115.1$$

Annual Savings = $-81.4

Simple Payback = [260 + 2.5 * 27.5] ÷ [8.9 - 81.4] = - 4.8 yrs

(1) Grainger, 1995, #386, p. 891

(2) Grainger, 1995, #386, p. 890

(3) MH installation time 2.5 hrs 92 Ele Means p 203

CONSTRUCTION COST ESTIMATE

Project:	ECO #LT4B2 Retrofit MV with Metal Halides	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/5/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTLT4B2.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
100-watt Metal Halide Lamp, Ballast and Fixture	6	ea	$360.00	$2,160	$69.00	$414	$2,574	MEp236	MEp236
Subtotal Bare Costs				$2,160		$414	$2,574		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$2,160		$414	$2,574		
City Cost Index (Aug. GA)			0%	$0	-46%	($190)	($190)	MMp533	MMp533
				-		-	-		
Subtotal				$2,160		$224	$2,384		
OH & Profit Markups			10%	$216	53%	$119	$335	MMp7	MMp475
				-		-	-		
Subtotal				$2,376		$343	$2,719		
Sales Taxes			6.0%	$143		NA	$143	MMp476	
				-		-	-		
Subtotal				$2,519		$343	$2,862		
Contingency			10%	$252	10%	$34	$286	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$2,771		$377	$3,148		
Design Fee				NA	6.0%	$172	$172		
SIOH				NA	6.0%	$172	$172		
				-		-	-		
Total Project Cost				$2,771		$721	$3,492		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: LT4B
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4B REPLACE MERCURY VAPOR FIXTURES
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 2 - METAL HALIDE FIXTURES
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 3150.		
B. SIOH	$ 189.		
C. DESIGN COST	$ 189.		
D. TOTAL COST (1A+1B+1C)	$ 3528.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 3528.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	12.	$ 91.	13.68	$ 1251.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		12.	$ 91.		$ 1251.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ -80.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ -1032.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ -1032.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 11.

5. SIMPLE PAYBACK PERIOD (1G/4) 308.39 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 219.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .06
(IF < 1 PROJECT DOES NOT QUALIFY)

LT4-10a

FTGORDON Lumen Method

Reynolds, Smith & Hills, Inc.
4651 Salisbury Road
Jacksonville, FL 32256

Lumen Method Computation
Generated by LitePro V2.27E
Provided and supported by USI Lighting, Inc.
Filename: FTGORDON Type: Indoor

Lumen Method Computation

Project name: EAMC Energy Audit	Project #
Prepared for: Savannah District COE	Date: 15-Feb-96
Prepared by: Paul Hutchins	

Area Name : 16X16 OFF T8 No. Identical Areas = 1
Description: 16x16 OFFICE
2X4 Parabolic recessed troffer fluorescents with T8s & Elect
ronic Ballasts

DIMENSIONS:	(Ft)	REFLECTANCES:	(Dec. %)
Width (E-W) :	16.00	Ceiling :	0.80
Length (N-S) :	16.00	North Wall :	0.50
Ceiling Height :	9.00	East Wall :	0.50
Mounting Height :	9.00	South Wall :	0.50
Workplane Height :	2.50	West Wall :	0.50
Total Area :	256.00	Floor Cavity:	0.20
RCR (Room Ratio) :	4.06		

ENVIRONMENTAL CONDITION: Clean # OBSTRUCTIONS: 0

Type F1 : TEST #7645, COLUMBIA, T8P2-243*-42363, P2
2'X4' 3L NON-REVEAL TROFFER, PARABOLIC- 3X6 CELL SPECULAR
LAMPS: (3) F032/31K, Lumens= 2900
BALLAST: EB, WATTS= 88
COEFFICIENT OF UTILIZATION: 58.7%

FACTORS:	....	PLACEMENT:	: ....
Luminaire Dirt :	0.85	Total Number :	4
Lamp Lumen Loss :	0.90	Pattern :	6.0X 6.0
Ballast :	0.90	# Columns/Rows :	2/2
Lamp/ballast :	1.00	Start Column (X) :	5.00
Misc :	1.00	Start Row (Y) :	5.00
>> Total LLF :	0.69		

PERFORMANCE:	....
Ave. Footcandles :	54.92
Watts/Sq. Foot :	1.38

******

Uses IES procedures for Lumen Method. USI is not responsible for light output of lamp/ballast, non-USI products, or design variables not shown.

LT4-11

FTGORDON 16X16 OFF T8 Costs

Reynolds, Smith & Hills, Inc.
4651 Salisbury Road
Jacksonville, FL 32256

Area Cost Analysis
Generated by LitePro V2.27E
Provided and supported by USI Lighting, Inc.
Filename: FTGORDON Type: Indoor

Area Cost Analysis

Project name: EAMC Energy Audit	Project #
Prepared for: Savannah District COE	Date: 16-Feb-96
Prepared by: Paul Hutchins	UPD: 1.4W/Sq.Ft

Area Name : 16X16 OFF T8 No. Identical Areas = 1
Description: 16x16 OFFICE
2X4 Parabolic recessed troffer fluorescents with T8s & Elect
ronic Ballasts

DIMENSIONS:	(Ft)	REFLECTANCES:	(Dec. %)
Width (E-W) :	16.00	Ceiling :	0.80
Length (N-S) :	16.00	North Wall :	0.50
Ceiling Height :	9.00	East Wall :	0.50
Total Area :	256.00	South Wall :	0.50
RCR (Room Ratio) :	4.06	West Wall :	0.50
		Floor Cavity:	0.20

ENVIRONMENTAL CONDITION: Clean # OBSTRUCTIONS: 0
LUMINAIRES:

Type F1 : TEST #7645 : TOTAL QUANTITY PER AREA = 4
COLUMBIA, T8P2-243*-42363, P2
2'X4' 3L NON-REVEAL TROFFER, PARABOLIC- 3X6 CELL SPECULAR
LAMPS: (3) F032/31K, Lumens= 2900
BALLAST: EB, WATTS= 88

LUMINAIRE COMPUTATIONAL PARAMETERS:

Type F1 : TEST #7645 : Luminaire >> T8P2-243*-42363

Total Light Loss Factor = 0.69	
Luminaire Dirt Depreciation	= 0.85
Lamp Lumen Depreciation	= 0.90
Ballast Factor	= 0.90
Lamp/ballast Factor	= 1.00
Misc Light Loss Factor	= 1.00
Lamp Lumen Ratio Factor = 1.00	
Original Lamp Rating	= 2900
Actual Lumens Used	= 2900
TOTAL CANDLEPOWER MULTIPLIER=	0.69

RS&H

SUBJECT		AEP NO	
		SHEET	OF
DESIGNER	Hutchins	DATE	2/14/96
CHECKER		DATE	

LT4C1 Compact Fluorescents in Restrooms

Replace existing 52-W incandescent with 15 watt fluorescent

Bulb	watt	lumens	Life	Price
A19 (inc.)	52	800	1000	\$0.69 (1)
SLS 15 (fl.)	15	900	10,000	22.21 (2) (3-tube)

Restroom operating hours:

4 hrs/da, 7 da/wk = 1456 hrs/yr.

Savings = $\frac{(52-15) * 14}{1000}$56*1258 = 67,771 kWh/yr

1258 lamps

231 MBtu/yr

Replacement cost savings

$$\frac{1258 * 1456 \frac{hr}{yr}}{1000 \frac{hr}{yr}} * \frac{\$7.57^{(3)}}{lamp} - \frac{1258 * 1456}{10{,}000} * 29.09 = \$8537/yr$$

(1) Grainger 1995 #386 p. 845

(2) p. 863

(3) Labor cost = $\frac{15 \text{ min/lamp}}{60 \text{ min/hr}} * \frac{\$27.50}{hr} = \frac{\$6.88}{lamp.}$

SPOT RELAMP

FT. GORDON EISENHOWER ARMY MEDICAL CENTER

SURVEY OF INCANDESCENT LAMPS FOR
REPLACEMENT WITH FLUORESCENT LAMPS

ROOM #	ROOM DESCRIPTION	# LAMPS
1D-02	REST ROOM	1
1D-03	REST ROOM	1
1D-44	REST ROOM	1
1G-02	REST ROOM	2
1G-03	REST ROOM	2
1J-23	REST ROOM	1
2B-32	REST ROOM	1
2C-18	REST ROOM	1
2C-19	JANITOR ROOM	1
2C-20	REST ROOM	1
2C-21	REST ROOM	1
2D-05	REST ROOM	1
2D-06	REST ROOM	1
2F-37	REST ROOM	1
2G-11	REST ROOM	1
2I-05	REST ROOM	1
2I-15	REST ROOM	1
2I-16	REST ROOM	1
2J-03	REST ROOM	1
2J-04	REST ROOM	1
2K-09	R/R & SHOWER	2
2K-11	R/R & SHOWER	2
2L-07	REST ROOM	1
2M-02	REST ROOM	1
2Q-06	REST ROOM	1
2Q-07	REST ROOM	1
2Q-38	REST ROOM	1
2R-22	REST ROOM	1
3F-12	REST ROOM	1
3F-13	REST ROOM	1
3G-04	JANITOR ROOM	1
3G-05	REST ROOM	1
3I-10	SHOWER ROOM	1
3K-06	REST ROOM	1
3K-28	REST ROOM	1
3K-30	REST ROOM	3
3K-38	REST ROOM	1
3L-07	JANITOR ROOM	1
4C-18	CONFERENCE ROOM	40
5A-03	REST ROOM	1
5A-04	REST ROOM	1
5A-16	REST ROOM	1
5A-17	REST ROOM	1
5A-20	SHOWER ROOM	2
5A-21	SHOWER ROOM	2
5A-22	SHOWER ROOM	2
5A-24	REST ROOM	1
5A-25	REST ROOM	1
5A-26	REST ROOM	1
5A-30	JANITOR ROOM	1
5A-33	REST ROOM	1
5A-34	REST ROOM	1
5B-02	REST ROOM	1
5B-07	REST ROOM	1
5B-10	REST ROOM	1
5B-11	PATIENT BED ROOM	2
5B-12	REST ROOM	1
5B-13	REST ROOM	1
5B-14	PATIENT BED ROOM	2
5B-15	PATIENT BED ROOM	2
5B-16	REST ROOM	1
5B-17	COMPUTER ROOM	2
5B-18	REST ROOM	1
5B-30	SHOWER ROOM	2
5B-33	SHOWER ROOM	2
5B-34	SHOWER ROOM	2
5B-37	SHOWER ROOM	2

ROOM #	ROOM DESCRIPTION	# LAMPS
5B-44	JANITOR ROOM	1
5B-45	PATIENT BED ROOM	2
5B-46	REST ROOM	1
5B-47	REST ROOM	1
5B-48	PATIENT BED ROOM	2
5B-49	PATIENT BED ROOM	2
5B-50	PATIENT BED ROOM	2
5B-51	PATIENT BED ROOM	2
5B-51	REST ROOM	1
5B-52	REST ROOM	1
5B-53	PATIENT BED ROOM	2
5B-54	REST ROOM	1
5B-55	REST ROOM	1
5B-57	REST ROOM	1
5C-01	PATIENT BED ROOM	2
5C-02	REST ROOM	1
5C-03	PATIENT BED ROOM	2
5C-04	REST ROOM	1
5C-05	PATIENT BED ROOM	2
5C-06	REST ROOM	1
5C-07	PATIENT BED ROOM	2
5C-12	REST ROOM	1
5C-13	PATIENT BED ROOM	2
5C-15	PATIENT BED ROOM	2
5C-16	REST ROOM	1
5C-18	REST ROOM	1
5C-20	REST ROOM	1
5C-22	REST ROOM	1
5C-23	PATIENT BED ROOM	2
5C-24	REST ROOM	1
5C-25	PATIENT BED ROOM	2
5C-26	REST ROOM	1
5C-27	PATIENT BED ROOM	2
5C-28	REST ROOM	1
6A-01	PATIENT BED ROOM	2
6A-02	REST ROOM	1
6A-03	PATIENT BED ROOM	2
6A-04	R/R AND SHOWER	2
6A-05	SHOWER ROOM	2
6A-06	PATIENT BED ROOM	2
6A-07	REST ROOM	1
6A-08	REST ROOM	1
6A-09	PATIENT BED ROOM	2
6A-10	PATIENT BED ROOM	2
6A-11	REST ROOM	1
6A-12	PATIENT BED ROOM	2
6A-13	R/R AND SHOWER	2
6A-15	PATIENT BED ROOM	2
6A-16	R/R AND SHOWER	2
6A-19	R/R AND SHOWER	2
6A-20	PATIENT BED ROOM	2
6A-22	REST ROOM	1
6A-23	REST ROOM	1
6A-24	PATIENT BED ROOM	2
6A-25	REST ROOM	1
6A-26	PATIENT BED ROOM	2
6A-34	SHOWER ROOM	2
6A-41	JANITOR ROOM	1
6A-48	KITCHEN	1
6B-01	PATIENT BED ROOM	2
6B-02	R/R AND SHOWER	2
6B-03	REST ROOM	1
6B-14	PATIENT BED ROOM	2
6B-15	REST ROOM	1
6B-16	MICROSCOPE ROOM	2
6B-17	REST ROOM	1
6B-18	PATIENT BED ROOM	2
6B-19	REST ROOM	1
6B-31	REST ROOM	2
6B-31	SHOWER	1
6B-36	R/R AND SHOWER	2

ROOM #	ROOM DESCRIPTION	# LAMPS
6B-36	SHOWER	1
6B-50	REST ROOM	1
6B-51	REST ROOM	1
6B-54	REST ROOM	1
6B-55	REST ROOM	1
6B-61	R/R AND SHOWER	2
6B-62	CLEAN LINEN ROOM	1
6B-63	PATIENT BED ROOM	2
6B-64	REST ROOM	1
6C-01	PATIENT BED ROOM	2
6C-02	REST ROOM	1
6C-03	PATIENT BED ROOM	2
6C-04	REST ROOM	1
6C-05	PATIENT BED ROOM	2
6C-06	REST ROOM	1
6C-07	PATIENT BED ROOM	2
6C-08	REST ROOM	1
6C-09	PATIENT BED ROOM	2
6C-10	R/R AND SHOWER	2
6C-11	SHOWER ROOM	2
6C-12	PATIENT BED ROOM	2
6C-13	R/R AND SHOWER	2
6C-14	CONFERENCE ROOM	2
6C-15	REST ROOM	1
6C-16	PATIENT BED ROOM	2
6C-17	REST ROOM	1
6C-20	SUPPLY ROOM	1
6C-30	R/R AND SHOWER	2
6C-31	PATIENT BED ROOM	2
6C-33	R/R AND SHOWER	2
6C-35	SHOWER ROOM	2
6C-36	REST ROOM	2
6C-37	PATIENT BED ROOM	2
6C-40	SHOWER ROOM	2
6C-41	R/R AND SHOWER	2
6C-42	PATIENT BED ROOM	2
6C-44	JANITOR ROOM	1
6C-45	SUPPLY ROOM	1
6C-48	PATIENT BED ROOM	2
6C-49	R/R AND SHOWER	2
6C-50	PATIENT BED ROOM	2
6C-51	REST ROOM	1
6C-52	PATIENT BED ROOM	2
6C-53	REST ROOM	1
7A-01	CONFERENCE ROOM	2
7A-02	PATIENT BED ROOM	2
7A-03	R/R & SHOWER	2
7A-04	PATIENT BED ROOM	2
7A-05	R/R & SHOWER	2
7A-07	PATIENT BED ROOM	2
7A-08	R/R & SHOWER	2
7A-09	SHOWER ROOM	2
7A-11	R/R & SHOWER	2
7A-12	SHOWER ROOM	2
7A-13	PATIENT BED ROOM	2
7A-14	R/R & SHOWER	2
7A-16	PATIENT BED ROOM	2
7A-17	REST ROOM	1
7A-18	PATIENT BED ROOM	2
7A-19	REST ROOM	1
7A-21	PATIENT BED ROOM	2
7A-22	REST ROOM	1
7A-23	REST ROOM	1
7A-24	PATIENT BED ROOM	2
7A-29	SHOWER ROOM	2
7A-30	PATIENT BED ROOM	2
7A-31	R/R & SHOWER	2
7A-32	SHOWER ROOM	2
7A-33	PATIENT BED ROOM	2
7A-34	R/R & SHOWER	2
7A-35	SHOWER ROOM	2

ROOM #	ROOM DESCRIPTION	# LAMPS
7A-36	PATIENT BED ROOM	2
7A-37	R/R & SHOWER	2
7A-39	PATIENT BED ROOM	2
7A-40	R/R & SHOWER	2
7A-41	CLEAN LINEN ROOM	1
7A-50	NURSE'S LOUNGE	2
7B-01	PATIENT BED ROOM	2
7B-02	REST ROOM	1
7B-04	PATIENT BED ROOM	2
7B-05	REST ROOM	1
7B-07	REST ROOM	1
7B-08	REST ROOM	1
7B-09	PATIENT BED ROOM	2
7B-10	REST ROOM	1
7B-12	JANITOR ROOM	1
7B-13	REST ROOM	1
7B-25	REST ROOM	1
7B-26	REST ROOM	1
7B-33	HOUSE KEEPER RM	1
7B-34	R/R & SHOWER	2
7B-35	PATIENT BED ROOM	2
7B-36	PATIENT BED ROOM	2
7B-37	R/R & SHOWER	2
7B-38	PATIENT BED ROOM	2
7B-39	REST ROOM	1
7B-41	REST ROOM	1
7B-48	PATIENT BED ROOM	2
7B-49	REST ROOM	1
7B-50	PATIENT BED ROOM	2
7B-51	REST ROOM	1
7B-52	PATIENT BED ROOM	2
7B-53	REST ROOM	1
7C-01	PATIENT BED ROOM	2
7C-02	REST ROOM	1
7C-03	PATIENT BED ROOM	2
7C-04	R/R & SHOWER	2
7C-06	PATIENT BED ROOM	2
7C-08	SHOWER ROOM	2
7C-09	PATIENT BED ROOM	2
7C-10	R/R & SHOWER	2
7C-11	SHOWER ROOM	2
7C-12	PATIENT BED ROOM	2
7C-13	R/R & SHOWER	2
7C-14	SHOWER ROOM	2
7C-15	PATIENT BED ROOM	2
7C-16	R/R & SHOWER	2
7C-18	PATIENT BED ROOM	2
7C-19	REST ROOM	1
7C-20	REST ROOM	1
7C-21	PATIENT BED ROOM	2
7C-22	REST ROOM	1
7C-23	REST ROOM	1
7C-25	PATIENT BED ROOM	2
7C-26	R/R & SHOWER	2
7C-27	PATIENT BED ROOM	2
7C-28	R/R & SHOWER	2
7C-29	LINEN CLOSET	1
7C-30	PATIENT BED ROOM	2
7C-31	R/R & SHOWER	2
7C-32	SHOWER ROOM	2
7C-33	PATIENT BED ROOM	2
7C-34	R/R & SHOWER	2
7C-35	SHOWER ROOM	2
7C-36	PATIENT BED ROOM	2
7C-37	R/R & SHOWER	2
7C-40	R/R & SHOWER	2
7C-49	NURSE'S LOUNGE	1
7C-50	REST ROOM	1
8A-03	R/R & SHOWER	2
8A-05	R/R & SHOWER	2
8A-08	R/R & SHOWER	2

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ROOM #	ROOM DESCRIPTION	# LAMPS
8A-09	SHOWER ROOM	2
8A-11	R/R & SHOWER	2
8A-12	SHOWER ROOM	2
8A-14	R/R & SHOWER	2
8A-17	REST ROOM	1
8A-19	REST ROOM	1
8A-22	REST ROOM	1
8A-23	REST ROOM	1
8A-29	SHOWER ROOM	2
8A-31	R/R & SHOWER	2
8A-32	SHOWER ROOM	2
8A-34	R/R & SHOWER	2
8A-35	SHOWER ROOM	2
8A-37	R/R & SHOWER	2
8A-40	R/R & SHOWER	2
8A-41	LINEN CLOSET	1
8A-50	NURSE'S LOUNGE	2
8B-02	REST ROOM	1
8B-03	JANITOR ROOM	1
8B-05	REST ROOM	1
8B-07	REST ROOM	1
8B-08	REST ROOM	1
8B-10	REST ROOM	1
8B-12	JANITOR ROOM	1
8B-13	REST ROOM	1
8B-25	REST ROOM	1
8B-26	REST ROOM	1
8B-34	R/R & SHOWER	2
8B-37	R/R & SHOWER	2
8B-39	REST ROOM	1
8B-41	REST ROOM	1
8B-47	R/R & SHOWER	2
8B-48	LOCKER ROOM	1
8B-50	R/R & SHOWER	2
8B-51	LOCKER ROOM	1
8B-53	REST ROOM	1
8B-55	REST ROOM	1
8B-56	TELEPHONE AREA	1
8C-02	REST ROOM	1
8C-04	R/R & SHOWER	2
8C-07	R/R & SHOWER	2
8C-08	SHOWER ROOM	2
8C-10	R/R & SHOWER	2
8C-11	SHOWER ROOM	2
8C-13	R/R & SHOWER	2
8C-14	SHOWER ROOM	2
8C-16	R/R & SHOWER	2
8C-19	REST ROOM	1
8C-20	REST ROOM	1
8C-22	REST ROOM	1
8C-23	REST ROOM	1
8C-26	R/R & SHOWER	2
8C-28	R/R & SHOWER	2
8C-29	LINEN CLOSET	1
8C-31	R/R & SHOWER	2
8C-32	SHOWER ROOM	2
8C-34	R/R & SHOWER	2
8C-35	SHOWER ROOM	2
8C-37	R/R & SHOWER	2
8C-40	R/R & SHOWER	2
8C-50	REST ROOM	1
9A-01	CONFERENCE ROOM	2
9A-02	PATIENT BED ROOM	2
9A-03	R/R & SHOWER	2
9A-04	PATIENT BED ROOM	2
9A-05	R/R & SHOWER	2
9A-07	PATIENT BED ROOM	2
9A-08	R/R & SHOWER	2
9A-09	SHOWER ROOM	2
9A-11	R/R & SHOWER	2
9A-12	SHOWER ROOM	2
9A-13	PATIENT BED ROOM	2
9A-14	R/R & SHOWER	2
9A-16	PATIENT BED ROOM	2
9A-17	REST ROOM	1
9A-18	PATIENT BED ROOM	2
9A-19	REST ROOM	1
9A-21	PATIENT BED ROOM	2

ROOM #	ROOM DESCRIPTION	# LAMPS
9A-22	REST ROOM	1
9A-23	REST ROOM	1
9A-24	PATIENT BED ROOM	2
9A-29	SHOWER ROOM	2
9A-30	PATIENT BED ROOM	2
9A-31	R/R & SHOWER	2
9A-32	SHOWER ROOM	2
9A-33	PATIENT BED ROOM	2
9A-34	R/R & SHOWER	2
9A-35	SHOWER ROOM	2
9A-36	PATIENT BED ROOM	2
9A-37	R/R & SHOWER	2
9A-39	PATIENT BED ROOM	2
9A-40	R/R & SHOWER	2
9A-41	CLEAN LINEN ROOM	1
9A-50	/R, NURSE'S LAUNG	2
9B-01	PATIENT BED ROOM	2
9B-02	REST ROOM	1
9B-04	PATIENT BED ROOM	2
9B-05	REST ROOM	1
9B-07	REST ROOM	1
9B-08	REST ROOM	1
9B-09	PATIENT BED ROOM	2
9B-10	REST ROOM	1
9B-12	JANITOR ROOM	1
9B-13	REST ROOM	1
9B-25	REST ROOM	1
9B-26	REST ROOM	1
9B-33	HOUSE KEEPER RM	1
9B-34	R/R & SHOWER	2
9B-35	PATIENT BED ROOM	2
9B-36	PATIENT BED ROOM	2
9B-37	R/R & SHOWER	2
9B-38	PATIENT BED ROOM	2
9B-39	REST ROOM	1
9B-41	REST ROOM	1
9B-48	PATIENT BED ROOM	2
9B-49	REST ROOM	1
9B-50	PATIENT BED ROOM	2
9B-51	REST ROOM	1
9B-52	PATIENT BED ROOM	2
9B-53	REST ROOM	1
9C-01	PATIENT BED ROOM	2
9C-02	REST ROOM	1
9C-03	PATIENT BED ROOM	2
9C-04	R/R & SHOWER	2
9C-06	PATIENT BED ROOM	2
9C-08	SHOWER ROOM	2
9C-09	PATIENT BED ROOM	2
9C-10	R/R & SHOWER	2
9C-11	SHOWER ROOM	2
9C-12	PATIENT BED ROOM	2
9C-13	R/R & SHOWER	2
9C-14	SHOWER ROOM	2
9C-15	PATIENT BED ROOM	2
9C-16	R/R & SHOWER	2
9C-18	PATIENT BED ROOM	2
9C-19	REST ROOM	1
9C-20	REST ROOM	1
9C-21	PATIENT BED ROOM	2
9C-22	REST ROOM	1
9C-23	REST ROOM	1
9C-25	PATIENT BED ROOM	2
9C-27	PATIENT BED ROOM	2
9C-30	PATIENT BED ROOM	2
9C-32	SHOWER ROOM	2
9C-33	PATIENT BED ROOM	2
9C-35	SHOWER ROOM	2
9C-36	PATIENT BED ROOM	2
9C-37	R/R & SHOWER	2
9C-40	R/R & SHOWER	2
9C-50	REST ROOM	1
10A-01	CONFERENCE ROOM	2
10A-03	R/R & SHOWER	2
10A-05	R/R & SHOWER	2
10A-08	R/R & SHOWER	2
10A-09	SHOWER ROOM	2
10A-11	R/R & SHOWER	2

ROOM #	ROOM DESCRIPTION	# LAMPS
10A-12	SHOWER ROOM	2
10A-14	R/R & SHOWER	2
10A-17	REST ROOM	1
10A-19	REST ROOM	1
10A-22	REST ROOM	1
10A-23	REST ROOM	1
10A-29	SHOWER ROOM	2
10A-31	R/R & SHOWER	2
10A-32	SHOWER ROOM	2
10A-34	R/R & SHOWER	2
10A-35	SHOWER ROOM	2
10A-37	R/R & SHOWER	2
10A-40	R/R & SHOWER	2
10A-41	CLEAN LINEN ROOM	1
10A-50	NURSE'S LOUNGE	2
10B-02	REST ROOM	1
10B-03	JANITOR ROOM	1
10B-05	REST ROOM	1
10B-07	REST ROOM	1
10B-08	REST ROOM	1
10B-10	REST ROOM	1
10B-12	JANITOR ROOM	1
10B-13	REST ROOM	1
10B-25	REST ROOM	1
10B-26	REST ROOM	1
10B-34	R/R & SHOWER	2
10B-37	R/R & SHOWER	2
10B-39	REST ROOM	1
10B-41	REST ROOM	1
10B-47	R/R & SHOWER	2
10B-48	LOCKER ROOM	1
10B-50	R/R & SHOWER	2
10B-51	LOCKER ROOM	1
10B-53	REST ROOM	1
10B-55	REST ROOM	1
10B-56	TELEPHONE AREA	1
10C-02	REST ROOM	1
10C-04	R/R & SHOWER	2
10C-08	SHOWER ROOM	2
10C-10	R/R & SHOWER	2
10C-11	SHOWER ROOM	2
10C-13	R/R & SHOWER	2
10C-14	SHOWER ROOM	2
10C-16	R/R & SHOWER	2
10C-19	REST ROOM	1
10C-20	REST ROOM	1
10C-22	REST ROOM	1
10C-23	REST ROOM	1
10C-32	SHOWER ROOM	2
10C-35	SHOWER ROOM	2
10C-37	R/R & SHOWER	2
10C-40	R/R & SHOWER	2
10C-50	REST ROOM	1
11A-01	PATIENT BED ROOM	2
11A-02	PATIENT BED ROOM	2
11A-03	R/R & SHOWER	2
11A-04	PATIENT BED ROOM	2
11A-05	R/R & SHOWER	2
11A-06	LINEN ROOM	1
11A-07	PATIENT BED ROOM	2
11A-08	R/R & SHOWER	2
11A-09	SHOWER ROOM	2
11A-11	R/R & SHOWER	2
11A-12	SHOWER ROOM	2
11A-13	PATIENT BED ROOM	2
11A-14	R/R & SHOWER	2
11A-16	PATIENT BED ROOM	2
11A-17	REST ROOM	1
11A-18	PATIENT BED ROOM	2
11A-19	REST ROOM	1
11A-21	PATIENT BED ROOM	2
11A-22	REST ROOM	1
11A-23	REST ROOM	1
11A-24	PATIENT BED ROOM	2
11A-29	SHOWER ROOM	2
11A-30	PATIENT BED ROOM	2
11A-31	R/R & SHOWER	2
11A-32	SHOWER ROOM	2

ROOM #	ROOM DESCRIPTION	# LAMPS
11A-33	PATIENT BED ROOM	2
11A-34	R/R & SHOWER	2
11A-35	SHOWER ROOM	2
11A-36	PATIENT BED ROOM	2
11A-37	R/R & SHOWER	2
11A-39	PATIENT BED ROOM	2
11A-40	R/R & SHOWER	2
11A-41	CLEAN LINEN ROOM	1
11A-50	NURSE'S LOUNGE	2
11B-01	PATIENT BED ROOM	2
11B-02	REST ROOM	1
11B-03	JANITOR ROOM	1
11B-04	PATIENT BED ROOM	2
11B-05	REST ROOM	1
11B-07	REST ROOM	1
11B-08	REST ROOM	1
11B-09	PATIENT BED ROOM	2
11B-10	REST ROOM	1
11B-12	JANITOR ROOM	1
11B-13	REST ROOM	1
11B-25	REST ROOM	1
11B-26	REST ROOM	1
11B-33	HOUSE KEEPER RM	1
11B-34	R/R & SHOWER	2
11B-35	PATIENT BED ROOM	2
11B-36	PATIENT BED ROOM	2
11B-37	R/R & SHOWER	2
11B-38	PATIENT BED ROOM	2
11B-39	REST ROOM	1
11B-40	BREAK ROOM	2
11B-41	REST ROOM	1
11B-48	PATIENT BED ROOM	2
11B-49	REST ROOM	1
11B-50	PATIENT BED ROOM	2
11B-51	REST ROOM	1
11B-52	PATIENT BED ROOM	2
11B-53	REST ROOM	1
11C-01	OFFICE ROOM	2
11C-02	REST ROOM	1
11C-03	PATIENT BED ROOM	2
11C-04	R/R & SHOWER	2
11C-06	PATIENT BED ROOM	2
11C-08	SHOWER ROOM	2
11C-09	PATIENT BED ROOM	2
11C-10	R/R & SHOWER	2
11C-11	SHOWER ROOM	2
11C-12	PATIENT BED ROOM	2
11C-13	R/R & SHOWER	2
11C-14	SHOWER ROOM	2
11C-15	PATIENT BED ROOM	2
11C-16	R/R & SHOWER	2
11C-18	PATIENT BED ROOM	2
11C-19	REST ROOM	1
11C-20	REST ROOM	1
11C-21	CONFERENCE ROOM	2
11C-22	REST ROOM	1
11C-23	REST ROOM	1
11C-25	PATIENT BED ROOM	2
11C-27	PATIENT BED ROOM	2
11C-29	LINEN CLOSET	1
11C-30	PATIENT BED ROOM	2
11C-32	SHOWER ROOM	2
11C-33	PATIENT BED ROOM	2
11C-35	SHOWER ROOM	2
11C-36	PATIENT BED ROOM	2
11C-37	R/R & SHOWER	2
11C-40	R/R & SHOWER	2
11C-41	STORAGE ROOM	1
11C-50	REST ROOM	1
12A-01	PATIENT BED ROOM	2
12A-02	PATIENT BED ROOM	2
12A-03	R/R & SHOWER	2
12A-04	PATIENT BED ROOM	2
12A-05	R/R & SHOWER	2
12A-06	STORAGE ROOM	1
12A-07	PATIENT BED ROOM	2
12A-08	R/R & SHOWER	2
12A-09	SHOWER ROOM	2

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ROOM #	ROOM DESCRIPTION	# LAMPS
12A-10	PATIENT BED ROOM	2
12A-11	R/R & SHOWER	2
12A-12	SHOWER ROOM	2
12A-13	PATIENT BED ROOM	2
12A-14	REST ROOM	1
12A-15	PATIENT BED ROOM	2
12A-16	REST ROOM	1
12A-17	PATIENT BED ROOM	2
12A-18	REST ROOM	1
12A-19	REST ROOM	1
12A-20	PATIENT BED ROOM	2
12A-21	REST ROOM	1
12A-22	REST ROOM	1
12A-23	PATIENT BED ROOM	2
12A-24	PATIENT BED ROOM	2
12A-25	R/R & SHOWER	2
12A-26	PATIENT BED ROOM	2
12A-27	R/R & SHOWER	2
12A-28	SHOWER ROOM	2
12A-29	PATIENT BED ROOM	2
12A-30	REST ROOM	1
12A-31	PATIENT BED ROOM	2
12A-32	REST ROOM	1
12A-33	PATIENT BED ROOM	2
12A-34	R/R & SHOWER	2
12A-35	STORAGE ROOM	1
12A-36	PATIENT BED ROOM	2
12A-37	REST ROOM	1
12A-45	REST ROOM	1
12A-46	NURSE'S LOUNGE	1
12A-51	REST ROOM	1
12A-51	SHOWER ROOM	2
12A-52	SHOWER ROOM	2
12B-01	PATIENT BED ROOM	2
12B-02	REST ROOM	1
12B-03	JANITOR ROOM	1
12B-05	REST ROOM	1
12B-06	REST ROOM	1
12B-07	OFFICE ROOM	2
12B-08	REST ROOM	1
12B-09	PATIENT BED ROOM	2
12B-10	REST ROOM	1
12B-11	PATIENT BED ROOM	2
12B-12	JANITOR ROOM	1
12B-13	REST ROOM	1
12B-22	STORAGE ROOM	1
12B-26	REST ROOM	1
12B-27	REST ROOM	1
12B-45	REST ROOM	1
12B-46	REST ROOM	1
12B-47	REST ROOM	1
12B-48	PATIENT BED ROOM	2
12B-49	PATIENT BED ROOM	2
12B-50	REST ROOM	1
12B-51	LINEN CLOSET	1
12B-52	OFFICE ROOM	2
12B-53	REST ROOM	1
12C-05	REST ROOM	1
12C-06	REST ROOM	1
12C-13	REST ROOM	1
12C-14	SHOWER ROOM	2
12C-15	PATIENT BED ROOM	2
12C-16	REST ROOM	1
12C-17	REST ROOM	1
12C-18	PATIENT BED ROOM	2
12C-19	REST ROOM	1
12C-25	REST ROOM	1
12C-26	REST ROOM	1
12C-32	SHOWER ROOM	2
12C-33	SHOWER ROOM	2
12C-34	SHOWER ROOM	2
12C-35	SHOWER ROOM	2
12C-41	REST ROOM	1
12C-42	NURSE'S LOUNGE	1
13A-01	PATIENT BED ROOM	2
13A-02	PATIENT BED ROOM	2
13A-03	R/R & SHOWER	2
13A-04	SUPPLY ROOM	1

ROOM #	ROOM DESCRIPTION	# LAMPS
13A-05	R/R & SHOWER	2
13A-06	PATIENT BED ROOM	2
13A-07	PATIENT BED ROOM	2
13A-08	R/R & SHOWER	2
13A-09	SHOWER ROOM	2
13A-10	PATIENT BED ROOM	2
13A-11	R/R & SHOWER	2
13A-12	SHOWER ROOM	2
13A-13	PATIENT BED ROOM	2
13A-14	REST ROOM	1
13A-15	PATIENT BED ROOM	2
13A-16	REST ROOM	1
13A-17	REST ROOM	1
13A-18	PATIENT BED ROOM	2
13A-19	REST ROOM	1
13A-20	REST ROOM	1
13A-21	PATIENT BED ROOM	2
13A-22	REST ROOM	1
13A-23	PATIENT BED ROOM	2
13A-24	PATIENT BED ROOM	2
13A-25	R/R & SHOWER	2
13A-26	SHOWER ROOM	2
13A-27	R/R & SHOWER	2
13A-28	PATIENT BED ROOM	2
13A-29	REST ROOM	1
13A-30	PATIENT BED ROOM	2
13A-31	PATIENT BED ROOM	2
13A-32	REST ROOM	1
13A-33	PATIENT BED ROOM	2
13A-34	R/R & SHOWER	2
13A-35	STORAGE ROOM	1
13A-36	PATIENT BED ROOM	2
13A-37	R/R & SHOWER	2
13A-38	LINEN CLOSET	1
13A-45	NURSE'S LOCKER	1
13A-46	REST ROOM	1
13A-52	SHOWER ROOM	2
13A-53	SHOWER ROOM	2
13B-01	PATIENT BED ROOM	2
13B-02	REST ROOM	1
13B-03	JANITOR ROOM	1
13B-05	REST ROOM	1
13B-06	REST ROOM	1
13B-07	PATIENT BED ROOM	2
13B-08	REST ROOM	1
13B-09	JANITOR ROOM	1
13B-10	PATIENT BED ROOM	2
13B-11	REST ROOM	1
13B-29	REST ROOM	1
13B-30	PATIENT BED ROOM	2
13B-32	REST ROOM	1
13B-33	PATIENT BED ROOM	2
13B-34	PATIENT BED ROOM	2
13B-35	REST ROOM	1
13B-42	PATIENT BED ROOM	2
13B-43	REST ROOM	1
13B-44	LINEN CLOSET	1
13B-45	PATIENT BED ROOM	2
13B-46	REST ROOM	1
13C-01	PATIENT BED ROOM	2
13C-02	REST ROOM	1
13C-03	REST ROOM	1
13C-04	PATIENT BED ROOM	2
13C-05	PATIENT BED ROOM	2
13C-06	R/R & SHOWER	2
13C-07	SHOWER ROOM	2
13C-08	SHOWER ROOM	2
13C-09	R/R & SHOWER	2
13C-10	PATIENT BED ROOM	2
13C-11	PATIENT BED ROOM	2
13C-12	R/R & SHOWER	2
13C-13	SHOWER ROOM	2
13C-14	PATIENT BED ROOM	2
13C-15	R/R & SHOWER	2
13C-16	PATIENT BED ROOM	2
13C-17	REST ROOM	1
13C-18	PATIENT BED ROOM	2
13C-19	REST ROOM	1
13C-20	REST ROOM	1

ROOM #	ROOM DESCRIPTION	# LAMPS
13C-21	PATIENT BED ROOM	2
13C-22	REST ROOM	1
13C-23	PATIENT BED ROOM	2
13C-24	PATIENT BED ROOM	2
13C-25	R/R & SHOWER	2
13C-26	STORAGE ROOM	1
13C-27	R/R & SHOWER	2
13C-28	PATIENT BED ROOM	2
13C-29	PATIENT BED ROOM	2
13C-30	R/R & SHOWER	2
13C-31	SHOWER ROOM	2
13C-32	PATIENT BED ROOM	2
13C-33	REST ROOM	1
13C-34	STORAGE ROOM	1
13C-35	R/R & SHOWER	2
13C-36	PATIENT BED ROOM	2
13C-37	PATIENT BED ROOM	2
13C-38	REST ROOM	1
13C-45	NURSE'S LOCKER	1
13C-46	REST ROOM	1
13C-52	SHOWER ROOM	2
	TOTAL	1258

LT4-14C

CONSTRUCTION COST ESTIMATE

Project:	ECO #LT4C1 Retrofit Restroom Incandescents with Compact Fluorescents	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	7/1/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTLT4C1.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
15-watt Compact Fluorescent	1258	ea	$22.21	$27,940	$0.69	$866	$28,806	Gp863	MEp238
Type SLS15									
Subtotal Bare Costs				$27,940		$866	$28,806		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$27,940		$866	$28,806		
City Cost Index (Aug. GA)			0%	$0	-46%	($398)	($398)	MMp533	MMp533
				-		-	-		
Subtotal				$27,940		$468	$28,408		
OH & Profit Markups			10%	$2,794	53%	$248	$3,042	MMp7	MMp475
				-		-	-		
Subtotal				$30,734		$716	$31,450		
Sales Taxes			6.0%	$1,844		NA	$1,844	MMp476	
				-		-	-		
Subtotal				$32,578		$716	$33,294		
Contingency			10%	$3,258	10%	$72	$3,330	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$35,836		$788	$36,624		
Design Fee				NA	6.0%	$1,998	$1,998		
SIOH				NA	6.0%	$1,998	$1,998		
				-		-	-		
Total Project Cost				$35,836		$4,784	$40,620		

LEGEND:

- MMp### 1996 Means Mechanical Cost Data, page ###.
- MEp### 1996 Means Electrical Cost Data, page ###.
- Gp### 1995 Grainger, page ###
- Dp### 2/94 DGSC Energy Efficient Lighting, page ###

LT4-14d

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: LT4C
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4C RETROFIT WITH COMPACT FLUORESCENTS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 1 - RESTROOMS
ANALYSIS DATE: 07-01-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 36600.	
B. SIOH	$ 2196.	
C. DESIGN COST	$ 2196.	
D. TOTAL COST (1A+1B+1C)	$ 40992.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 40992.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	231.	$ 1760.	13.68	$ 24080.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		231.	$ 1760.		$ 24080.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 8537.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 110127.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 110127.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 10297.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.98 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 134207.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.27
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

RS&H

SUBJECT
DESIGNER Hutchins
CHECKER

AEP NO
SHEET OF
DATE 2/14/96
DATE

LT4C2 Compact Fluorescents in Lobby Area Downlights

Replace existing 52-w incandescent with 18-watt compact with reflector

Bulb	watt	lumens	life	Price
A19 (inc.)	52	800	1000	\$0.69 (1)
SL18/R40 (fl.)	18	800	10,000	\$27.22 (2)

Annual operating hrs.

10 hrs/da * 7 da/wk = 3640 hrs/yr.

Savings: 31 lamps

$$\frac{(52-18) * 3640 * 31}{1000} = 3837 \text{ kwh/yr}$$

$$= \underline{\underline{13}} \text{ MBtu/yr.}$$

Replacement cost savings ~~for~~ 31 lamps

$$\frac{31 * 3640}{1000} * 7.57 - \frac{31 * 3640}{10{,}000} * 29.09 = \$\underline{\underline{525}} \text{ /yr.}$$

(1) Granger p. 345

(2) Gp 863

(3) Labor cost = $\frac{45 \text{ min}/\overset{3}{\text{lamps}}}{60 \text{ min/hr}} * \$27.50 = \$\frac{6.88}{\text{lamp}}$

Spot relamp 3 at a time

LT4-15a

CONSTRUCTION COST ESTIMATE

Project:	ECO #LT4C2 Retrofit Downlight Incandescents with Compact Fluorescents	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	7/1/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTLT4C2.XLS

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL COST	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total		Material	Labor
18-watt Compact Fluorescent	31	ea	$27.22	$844	$0.69	$21	$865	Gp863	MEp238
Type SL18/R40									
Subtotal Bare Costs				$844		$21	$865		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$844		$21	$865		
City Cost Index (Aug. GA)			0%	$0	-46%	($10)	($10)	MMp533	MMp533
				-		-	-		
Subtotal				$844		$11	$855		
OH & Profit Markups			10%	$84	53%	$6	$90	MMp7	MMp475
				-		-	-		
Subtotal				$928		$17	$945		
Sales Taxes			6.0%	$56		NA	$56	MMp476	
				-		-	-		
Subtotal				$984		$17	$1,001		
Contingency			10%	$98	10%	$2	$100	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$1,082		$19	$1,101		
Design Fee				NA	6.0%	$60	$60		
SIOH				NA	6.0%	$60	$60		
				-		-	-		
Total Project Cost				$1,082		$139	$1,221		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: LT4C
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-LT4C RETROFIT WITH COMPACT FLUORESCENTS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION 2 - LOBBY DOWNLIGHTS
ANALYSIS DATE: 07-01-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 1100.		
B. SIOH	$ 66.		
C. DESIGN COST	$ 66.		
D. TOTAL COST (1A+1B+1C)	$ 1232.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1232.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	13.	$ 99.	13.68	$ 1355.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		13.	$ 99.		$ 1355.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 525.
(1) DISCOUNT FACTOR (TABLE A)	12.90	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 6773.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 6773.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 624.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.97 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 8128.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 6.60
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 14.95 %

LT4-15C

RS&H			
SUBJECT		AEP NO	
		SHEET	OF
DESIGNER	Hutchins	DATE	1/23/96
CHECKER		DATE	

ECO LT7 HARMONIC ANALYSIS MEASUREMENTS
PANEL RP2 - 277 volts

#	FLR	CIRC#	
1	10	2	
2	10	PN	(neutral with power feed)
3	11	2	
4	11	4	
5	11	6	
6	11	PN	(neutral with power feed)
7	11	LN	(neutral to load)
8	10	4	
9	10	6	
10	10	LN	(neutral to load)

10 th FLR circuit #2 - 25 2L fixtures 3 are T12's
(2 in stairwell, 1 in elec closet)

11 th FLR Circuit #2 - 30 2L fixtures - all T12's

Calc expected current 2-F40 T12 lamps, 277v

Ballast Type	Amps	watts
Std	0.34	92
EEM	0.32	86
Electronic	0.21	58

			Amps	AVG Amp/FIXT
10 th FLR C#2	22 * 0.21 + 3 * 0.33	=	5.61	0.224
11 th FLR C#2	30 * 0.33	=	9.90	0.330

Understanding the Effects of Harmonic Distortion

Installing ballasts designed without regard to limiting total harmonic distortion (THD) can have damaging effects on electrical systems. To avoid these problems, engineers must have an understanding of what harmonics are and how to limit them.

Typically expressed as a percent of 60-hertz power supply, total harmonic distortion is the sum of harmonic currents on the neutral conductor. In a balanced, three-phase, harmonic-free system, no current is carried on the neutral conductor. When harmonic currents are present, odd triplen multiples (180 hertz, 540 hertz, [etc.]) of the 60-hertz fundamental frequency add together to result in a high amount of current on the neutral conductor.

In a three-phase, four-wire system, the neutral conductor carries harmonic currents produced by all three phases—which could result in the neutral conductor carrying more current than any one of the phase conductors. Overheating of neutral conductors, bus bars and transformers are problems caused by harmonic currents.

How much THD is acceptable? For magnetic ballasts, a THD of 15 percent to 20 percent is not uncommon, and in some cases, it can be as high as 37 percent. The American National Standards Institute (ANSI) THD design standard for magnetic ballasts is 32 percent. Today, most electronic ballasts are designed to a 20 percent maximum THD. This value has been driven by specification writers and some utilities that require a maximum 20 percent THD to qualify for lighting rebates.

But lighting load is only part of the total electrical system. Harmonic currents are produced by personal computers; variable-frequency motor drives; and any number of other systems that employ computers or computer-controlled equipment. If the system serves a harmonic-rich environment, even 20 percent from the lighting can be undesirable.

Consequently, harmonic-producing loads should not be added indiscriminately to an electrical system. They should first be evaluated for their effect on system components.

To limit THD to less than 20 percent, several ballast manufacturers employ a passive filter on the ballast input. Some manufacturers market a "low-harmonic" ballast with an active filter to limit THD to less than 10 percent. These ballasts may exhibit high inrush current, which can damage the contacts of some switches, occupancy sensors or lighting contactors. Some inrush currents exceed 30 amps per ballast, which is twice that of the passive-filter ballast. The sum of currents can reach up to several hundred amps per circuit.

If a low-harmonic ballast is specified, switching devices and branch-circuit elements must be evaluated for their ability to withstand associated inrush currents. If the devices cannot withstand the currents, a specification must be written outlining the device requirements. Lighting branch circuits may need to be reviewed and revised. Putting fewer fixtures on a branch circuit will help limit inrush current seen by that circuit. □

FIGURE 1 – HARMONIC CURVE VALUES (ELECTRONIC BALLASTS)

PHASE A	AMPS
Peak:	67.2
RMS:	47.5
Average:	43.5
Avg. RMS:	48.4
Cf: 1.41	0%
Ff: 1.09	2%
CBEMA Df:	1.00

HARMONIC	% DISTORTION	% TOTAL
F		75.3
2	0.3	0.2
3	16.9	12.7
4	0.1	0.1
5	7.5	5.7
6	0.2	0.1
7	1.8	1.3
8	0.3	0.2
9	1.6	1.2
10	0.3	0.2
11	1.0	0.8
12	0.3	0.2
13	1.2	0.9
14	0.1	0.1
15	1.0	0.8

Total Odd: 18.8
Total Even: 0.7
Total Triplen: 17.0
Total HD: 18.8
Kf: 1.5

FIGURE 2 – HARMONIC CURVE VALUES (MAGENTIC BALLASTS)

PHASE A	AMPS
Peak:	138
RMS:	97
Average:	84
Avg. RMS:	94
Cf: 1.42	1%
Ff: 1.15	3%
CBEMA Df:	0.99

HARMONIC	% DISTORTION	% TOTAL
F		77.9
2	0.2	0.2
3	11.2	8.7
4	0.2	0.1
5	10.6	8.2
6	0.1	0.1
7	2.3	1.8
8	0.1	0.1
9	1.4	1.1
10	0.2	0.1
11	0.9	0.7
12	0.2	0.1
13	0.5	0.4
14	0.1	0.1
15	0.4	0.3

Total Odd: 15.7
Total Even: 0.4
Total Triplen: 11.3
Total HD: 15.7
Kf: 1.4

Electronic ballasts, when first introduced, were thought to be a significant cause of harmonic-distortion problems in electrical-distribution systems. However, scrutiny of harmonic curves has shown that the amount of harmonic activity produced by both electronic and magnetic ballasts is comparable.

LT4-17

RS&H®

Telephone Call Confirmation

Project Number ______
(703) 390-5702

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 2/14/96

Conversed with Michael Ostaffe Of Advance Transformer

Regarding Inrush current on electronic ballasts

HTTP://PUBWEB.ACNS.NWU.EDU/~MOSTAFFE/
HOMEPAGE.HTM

25% loss for greater than 7 on/offs per day

MJO@NWU.EDU E-MAIL

Distribution:

LT4-18

MOTOROLA
Motorola Lighting Inc.

TECHNICAL BULLETIN
VOLUME 5
NUMBER 1

HIGH FREQUENCY FLUORESCENT BALLASTS AND INRUSH CURRENT

This technical bulletin discusses the operation of electronic fluorescent ballasts and the generation of inrush or backrush currents in the AC power distribution system. Information presented explains the cause of inrush or backrush current. A properly designed system is able to accommodate inrush or back rush currents. A chart of system component selection guidelines is provided at the end of this document.

Every electrical or electronic device uses power in order to function. This power is obtained from the AC power distribution system and is referred to as a specific amount of current in amperes or amps, at the power line voltage of 120 volts or 277 volts. The current which is required during constant-on operation is called "steady state current" and does not change once the device has reached level operation.

During the start-up period, some electronic devices such as personal computers, fax machines, or electronic ballasts, require a momentary, higher level of current in order to charge a capacitor. This short, increase in current level lasts up to five one-thousands of a second (0.005sec) and is called "inrush current". Capacitors are needed in the device's power supply to provide energy to the load when the line voltage is near or at zero (which occurs 120 times a second).

Some electronic ballasts use an inductor at the front end of their power supply to control performance characteristics. If an inductor is used, a condition called "backrush, or, "back Electro-Magnetic Force (EMF)", may occur. Back EMF may cause a large spike of current to occur when the electronic device is turned off.

Electronic ballasts typically contain capacitors or inductors in the front end of their power supplies. This will increase the likelihood of either inrush or backrush occurring. If either condition occurs, and the auxiliary equipment has not been designed to withstand either inrush or backrush, then the auxiliary equipment's life or function may be impaired. Auxiliary equipment includes circuit breakers, energy management control relays, occupancy sensors, and wall switches.

In addition, some ballasts which are advertised as having low inrush do so by using a negative resistance component called a thermistor to limit initial current. As the thermistor heats up, its resistance decreases and it assumes a passive role in the operation of the ballast. However if for any reason the power to the ballast circuit is momentarily interrupted, the thermistor will still be at its hot, low resistance level and will be ineffective in limiting inrush current.

Peak circuit inrush is less than the sum of the inrush of all the ballasts in the circuit because of the limiting effect of line impedance (line sag). Each ballast has a typical inrush time of about 0.5 to 1.0 milliseconds (0.0005 to 0.001seconds), and the total circuit in-rush time is about 2.5 milliseconds.

Since inrush varies model by model even for a given ballast manufacturer, contrary to what some have been led to believe, selecting an electronic ballast with a higher percentage value for total harmonic distortion (THD) will not insure that the selected ballast has a low inrush value. For example, the Motorola Lighting Inc. M2-IN-T8-277 ballast model (less than 10% THD) has a very low inrush of less than 5 amps, while the measured inrush current of most other instant start 277 volt ballasts in the marketplace (THD between 10% and 20%) is higher.

Each ballast manufacturer should be consulted for quantitative inrush and backrush information regarding their specific products and the lighting system designer should take these characteristics into account during the design phase of the system.

Inrush or backrush current, if not considered during system design, could possibly, in some isolated situations, cause false tripping of circuit breakers or welding of contacts in relays, sensors or switches. However, an industrial series circuit breaker can withstand 500 amps for a time interval up to one cycle, or 16.667 milliseconds, and therefore, will not be affected by inrush. Use of relays having industrial ratings addressed in the attached chart will eliminate the possibility of relay contacts welding due to inrush.

The only appropriate way in which to address inrush or backrush current is to do so at a system level by selecting components which are designed to function reliably with these loads. The following system or component design guidelines should be followed in order to provide a reliable system.

System Component Guidelines

COMPONENT OR CHARACTERISTIC	DESCRIPTION
Wire Size	Number 12 AWG, 600 volt insulation. wire should be used between the luminaire and the energy management control relays, occupancy sensors, or wall switches. Number 18 AWG solid copper wire should always be used within the luminaire for all ballast connections.
Max. Input Power Level	The continuous load must not exceed 16 amperes (80% of the typical component rating of 20 amperes)
Circuit Breaker	Use a heavy-duty industrial grade breaker that can withstand a peak of 50 to 100 times its ampere rating for 1/4 of a cycle
Control Relay	Mechanical relays must be industrial grade rated for 20 amperes resistive and inductive lighting loads at 120 and 277 volts. The relay should be rated for a minimum of 30,000 operations, and shall be UL listed and CSA certified. The relay must withstand 1000 ampere in-rush. Relay contacts must be silver alloy material and contain bifurcated coil to prevent damage from continuous on and off signals.
Wall Switch or Wallbox Dimmers	Switches of dimmers must be industrial grade and rated for 20 amperes at 120 and 277 volts alternating current, and 1 HP at 120 volts and 2 HP at 240 volts. Switches must have silver alloy contacts. Switches must be UL Listed, CSA Certified, comply with UL 20, and meet Federal specification WS-896.

Always consult your ballast manufacturer for more specific instructions and design requirements prior to installation. For additional information on inrush currents of Motorola Lighting Inc. electronic ballasts, please call **1-800-ML1-0089.**

LT4-20

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Inrush Current

There has been much discussion in the last few months regarding high inrush currents being associated with high frequency electronic ballasts. Following is a technical overview of the subject.

What is it?

Devices with solid state power supplies, such as computers, copiers, and electronic ballasts, as well as many magnetic devices such as motors, drives, and core & coil ballasts, have an input current during initial start-up that can be several times greater than their operating or steady-state current. This current during start-up is generally referred to as *Inrush Current*. For High Frequency Electronic Ballasts, this current during start-up typically lasts for much less than 1/2 of a 60 Hz cycle (<8 msec).

What are the effects?

High current conditions can affect electrical system components. The main area of concern is the tripping of circuit breakers and fuses. If the circuit breaker or fuse is not designed to handle the amount of inrush current that is present, the device could trip upon energizing the circuit or during circuit operation.

It has been suggested that during turn-on, momentary contact bouncing in the switch or relay may cause the contacts to become pitted due to arcing between the contacts points. This can be present in all systems, and is not a direct result of inrush current. However, the higher the overall system current, the faster contact deterioration may occur.

Since inrush current is only present during initial system energization, it is not a factor during system turn-off.

What amount is present in your lighting system?

Inrush current is present in both magnetic and electronic ballasts. The amount of ballast inrush current varies across manufacturers, ballast types, and ballast brands. In addition, the inrush current of a complete lighting circuit is affected by the total source impedance of the entire distribution system. A system with a low impedance can deliver a greater amount of inrush current to the ballast(s) than a circuit with a high impedance.

The system impedance is determined by several electrical distribution system variables. These variables include the impedance of the main transformer; the distance of the lighting circuit to the main transformer; the type and size of wire between the branch circuit and transformer; the wire size and wire type of the lighting branch circuit, and the length of the wires in the lighting branch circuit. These variables determine the maximum amount of current that can be delivered to the ballast(s) at the moment of turn-on.

Electronic ballasts are generally characterized into two groups, those with an *active* front-end, and those with a *passive* front-end. The term *front-end* refers to the power input section of the ballast.

Generally, electronic ballasts with *active* front ends have Total Harmonic Distortion below 10%, and *passive* front ends typically have THD below 20%. However, due to multiple circuit designs, and the continuous design changes that are evolving, this may not always be the case.

The *active* ballasts typically have low impedance during start-up, due to the need to charge the system circuitry. Many *passive* ballasts typically have an inductive choke on the front-end, which has a higher impedance, resulting in a lower inrush current. *Active* electronic ballasts can have inrush currents as high as 100 times or more its operating current, with a duration of up to .8 milliseconds. *Passive* electronic ballasts with an input choke can have an inrush current of up to 30 times operating current, with a duration up to 5 milliseconds. This is compared to magnetic ballasts that have an inrush current of up to 10 times the operating current, with a duration of under 10 milliseconds.

Based on the assumption of inrush current being 100 times the magnitude of the steady state current, a 20 amp circuit loaded to 16 amps could have an inrush current as high as 1600 amps (16 x 100). However, due to system impedances the total system inrush will probably not reach the theoretical maximum calculated.

Previous laboratory testing of sample ballasts has shown an inrush current of 75 amps on a 120V, 20 amp system loaded to 16 amps with two-lamp *active* electronic ballasts. Total duration was approx. 5 milliseconds.

These lab results show a significantly lower circuit inrush current, with a greater duration, than the theoretical calculations for a single ballast predict. These results are only valid for one type of ballast in a controlled environment, and extrapolation to any other location is not possible without first investigating all system parameters. All things considered, the likelihood of achieving the maximum inrush is probably very slight.

What can you do?

When planning a new or retrofit ballast installation, take the following steps in order to reduce potential inrush current problems.

- ***First***, determine the inrush current drawn by the ballast you have selected. A range may be supplied by the manufacturer due to the various system impedances encountered in laboratory testing.
- ***Second***, calculate the theoretical maximum inrush current for the circuit based on the circuit values for your specific installation (wire size, length, etc.).
- ***Third***, select a fuse or circuit breaker that is capable of handling the inrush current for the duration of the inrush. Typically, fuses and breakers are rated to handle inrush currents that are several multiples of their steady-state ratings.
- ***Fourth***, select switches and contacts that are able to withstand the inrush current. All switches and contacts in the circuit, both locally and at the electrical or lighting panel, should be properly sized. Contact your switch manufacturer to determine the proper unit. If occupancy sensors or other control devices are to be used on the circuit, contact the sensor manufacturer to ensure compatibility with the type and number of ballasts being controlled.

For further information on the inrush current present in Advance electronic ballasts, please call Advance Technical Service at 1-800-372-3331.

Always follow the National Electric Code and state and local codes when designing and installing any lighting or electrical system.

This publication is intended to provide general educational and background information on the issue of inrush currents, and not definitive solutions to specific installation issues.

Michael J. Ostaffe
Electronic Product Manager
ADVANCE TRANSFORMER CO.

HE JOURNAL OF POWER JALITY ISSUES & SOLUT ONS

TODAY™

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PowerCET Corporation and
Kreiss-Johnson Technologies

LT4-24

Increasing Level of Nonlinear Loads Adds to Harmonic Woes

Harmonic currents can lower performance and shorten the life of electronic components like the inductor shown here.

The impact of harmonics on the quality of electrical power continues to be a critical concern for industrial and commercial users.

The electrical environment has become harmonic rich, thanks to the nearly universal application of electronic switching devices. These switching devices, found in virtually every desktop computer and in an increasingly large number of fluorescent lighting fixtures and in motor controls, are high efficiency , energy saving improvements.

But the energy savings have often come at a serious price: overheated transformers, excessive neutral currents, pitted bearings and overstressed components like the inductor in the photo at left.

The effects of these energy saving devices can be severe. The European economic community, in fact, has legislated them out of existence by requiring that most devices that produce serious harmonic distortion have built-in power factor correction to eliminate their effects on the distribution system.

Here in the United States, the standard for harmonics, IEEE Std. 519-1992, addresses the effects of harmonics at the point of common coupling (PCC). The IEEE standard has been adopted by a number of utilities as a means to control harmonic loading and will probably become the industry norm.

In the meantime, the economic consequences of harmonic loads could very well be greater than the energy cost savings delivered by these nonlinear loads, unless appropriate actions are taken to mitigate their effects. Fortunately there are devices and techniques available that can lessen the undesirable effects brought about by the proliferation of nonlinear loads.

SEE CENTER SPREAD FOR MORE ON HARMONICS

Please Mention **The Lighting Resource** in your communications - Thank You

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RS&H

Telephone Call Confirmation

Project Number (800) 654-0089

Local ____ L.D. ✓ Placed ____ Rec'd ____ Date 2/12/96

Conversed with Robert Payne Of Motorola Customer Service

Regarding In-rush current on low THD ballasts

Rob will send fax on this subject

Distribution:

LT4-26

Chapter 59
A Prescription for Quality Lighting in Hospitals

T.A. Damberger

ABSTRACT
The Sun produces a full spectrum of electromagnetic waves, from cosmic rays to radio waves. Visible light is only a very small segment of the electromagnetic spectrum that the human eye can perceive. Good quality lighting is of great importance to all of us, whether in the work place or at home. Light can have a positive effect on our behavior, productivity and health. It influences our health, how we feel, think, learn and work. Light is used beneficially in the treatment of disease, disorders and may even influence recovery times for patient care. Lighting is also a major consumer of energy, and as such, offers a unique opportunity to improve energy efficiency while enhancing the environment. It is therefore essential in the development of a system approach toward quality lighting that you promote good health and a sense of well being while concurrently optimizing energy efficiency.

HEALTH CARE FACILITIES

Kaiser Permanente is the nation's largest prepaid health maintenance organization. The Southern California Region consists of about 200 buildings representing 10 million square feet. Our facilities include numerous acute care hospitals, medical office buildings, office buildings, warehouses, data centers, records centers, call centers, laboratories and parking structures.

Hospitals are complex institutions that have a variety number of tasks being carried out by doctors, nurses, administrators, maintenance and other personnel. Lighting consideration for the many different areas are as varied as their functions. Providing illumination for general and task lighting in these varied environments requires special skills. Attention to spatial distribution visual comfort, glare, color rendition, efficacy and conservation become part of the prescription for quality lighting in health care facilities. Lighting quality and quantity optimization is difficult at best. The challenge is to balance energy conservation without compromising quality lighting for the specific visual task.

Care must also be given to avoid overexposure of the patient's retina. The retina of the human eye is most sensitive to light between 400 and 1400 nanometers (nm).

Lighting in all areas, including patient care areas, must enhance chromaticity (colors) and provide high visual comfort probability (VCP) (reduced direct glare). The spectral distribution from a light source and color rendition affects visual fatigue. It also affects the way the eye focuses, as well as the accuracy and speed with which certain tasks are performed. With proper lighting, eye fatigue can be reduced and human performance be improved. Also some people believe that proper lighting and decor can have a soothing effect in the promotion of the healing process.

THE POWER OF LIGHT

The Sun produces a full life-giving spectrum of electromagnetic waves shown in figure 1. Light is only a very small segment of the electromagnetic spectrum that we can see. Radio, television and light waves travel at the same speed of 186,000 miles per second. Of particular interest for this discussion is the ultraviolet, visible and infrared spectrum. The human eye can see only a very narrow part of the electromagnetic spectrum, in the range between 380 and 770 nm.

Proper lighting in the work place and at home can have a positive effect on human behavior, productivity and health. The photobiological responses of light influence our health, including how we feel, think, learn and work. Lighting is also a major consumer of energy. In the medical care community, quality lighting offers a challenging opportunity to enhance environmental quality while balancing energy efficiency. Our objective is to develop lighting systems that illuminate appropriately, provide aesthetic quality, promote better health, less absenteeism and a sense of well-being while concurrently optimizing energy efficiency. Lighting can be a robust

LT4-27

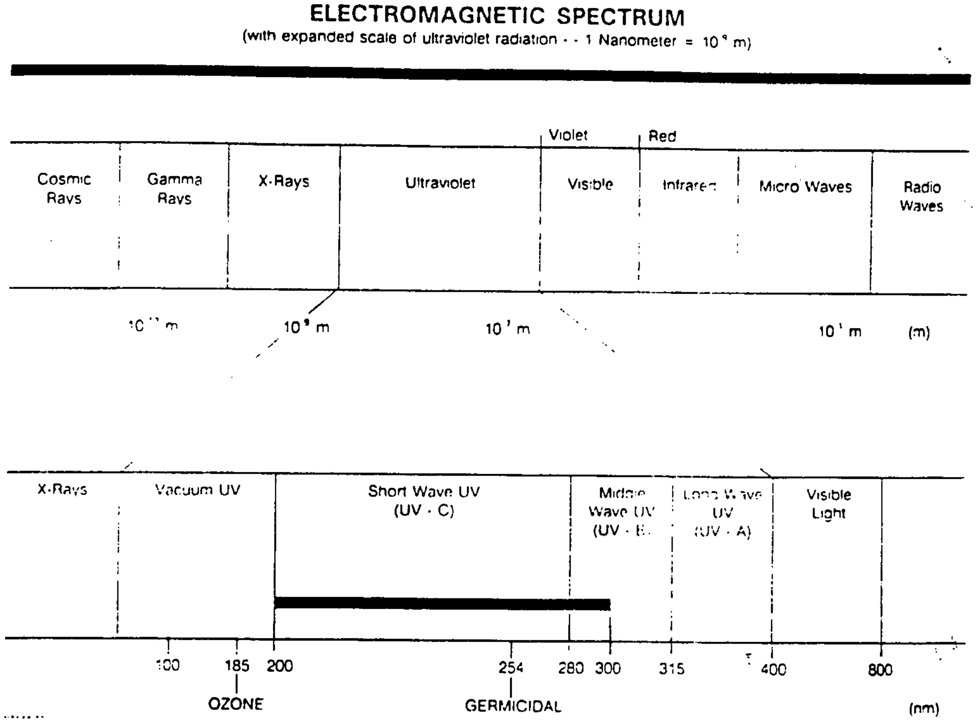

Figure 1

resource for a facility or a powerful detriment to productivity.

Natural light is an obvious human preference as compared to artificial lighting. Our inherent affinity for sunlight can lead to an overstimulation that will lead to fatigue and declining performance. Too little natural light will also lead to declining performance. Therefore, the challenge is to find a delicate balance between too much and too little natural light when designing lighting systems.

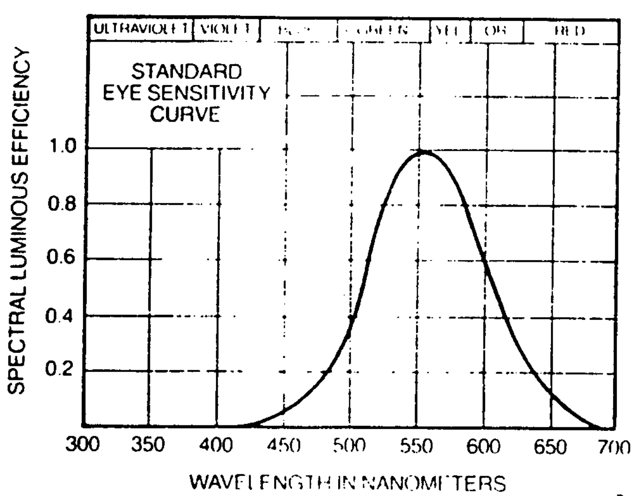

Figure 2

Generally, chronic eye fatigue can be reduced or eliminated by controlling direct glare (from lights, windows, etc.) and reflected glare from task lighting. The latter can be annoying, and it often reduces contrast making it difficult to perform a visual task.

Sensitivity of the human eye across all wavelengths of colors is not equally distributed. Psychophysical research lead to a spectral luminous efficiency curve that shows the relative brightness sensitivity of the eye at various wavelengths. Physiological response of the human eye for peak spectral sensitivity is at about 555 nm, or more commonly called the yellow green wavelength (figure 2). Conversely, red and blue responses are very low in comparison. When performing a lighting retrofit in a facility some individuals either complain or complement the changes depending on their particular sensitivity to a color change, brightness or color rendering of objects. Others may not even notice a change.

THE BIOLOGICAL RESPONSE

The biological effects of light on the human body is known in several areas. For instance, light stimulates production of vitamin D when the skin is exposed to light. Important as it is, this beneficial effect is more important with the elderly and the ailing, whose exposure to natural light is limited. Phototherapy (light therapy) is also commonly used therapeutically to treat effects caused by Seasonal Affective Disorder (SAD), psoriasis, neonatal jaundice and dentistry. Systematic exposure to bright light can overcome certain disabling effects caused by SAD as well as a myriad of other maladies. Studies of light on laboratory animals established significant positive

LTY-28

impacts on the physical activity level, growth, production of a precursor of vitamin D, life spans and reproductive responses.

Skin is stimulated by light to produce a precursor of Vitamin D. Light is also known for its role in the deposition of calcium and can be an effective aid in promoting the soundness of teeth and bones and may even prevent rickets. The region of light spectrum where these human physical responses occur is in the 280-320 nm range.

Clearly there is a need for more research, not necessarily concerning just energy savings. The need is for research on the effective application of light to maintain or enhance human performance.

ULTRAVIOLET LIGHT

Ultraviolet light is primarily the invisible part of the spectrum whose wavelengths are shorter than those of the violet end of the visible spectrum. It is longer than those of X-rays. The UV spectrum is usually considered to extend from about 50 to 400 nm. The UV spectrum is divided into three regions, which are designated as UV-A, UV-B and UV-C. Both UV-A and UV-B are of interest when considering lighting within a building in terms of photosensitive lupus patients. Literature generally indicates that adverse reactions and photo-sensitivity for lupus patients is mostly in the UV-B range.

> UV-A (long-wave) generally occurs between 315 to 400 nm band and is considered the black light region.
>
> UV-B (middle-wave) generally occurs between 280 to 315 nm and is commonly known for its use erythemally for tanning.
>
> UV-C (short-wave) generally occurs between 100 to 280 nm and is in the ozone-producing spectrum (185 nm). UV-C is typically screened out by the Earth's atmosphere and is rarely found in a natural state on Earth.

THE FLUORESCENT LAMP

The principle of producing light using a fluorescent lamp was first developed about 1938 with the introduction of the 18-inch T-8 lamp. The fluorescent lamp is an electric discharge device which utilizes a low pressure mercury vapor arc to generate UV energy. This is a form of plasma energy, which by definition, is a highly ionized gas that is electrically conductive. The UV energy produced in this process is absorbed by a phosphor coat on the inside of the glass tube and converted by the phosphor to visible wavelengths. This phenomenon is known as fluorescence. The distribution of multiple wavelengths of light is determined by the phosphor composition. This in turn determines the color appearance of the light and the color rendering properties of the lamp.

How do fluorescent lamps work? Simply stated, fluorescent lamps have electrodes coated with emissive material that emits electrons. These electrons are accelerated by the voltage between the electrodes until they collide with mercury atoms. A collision excites the outer orbital electrons in the atom. For example, the collision raises the electrons to higher energy levels and knocks them out of the atom. These electrons radiate power when they return to the unexcited state. While some light is radiated, the principal radiation is at 254 nm in the UV spectrum. The UV is absorbed by the phosphor coating on the inside of the glass shell where it is converted to visible light as shown in figure 3.

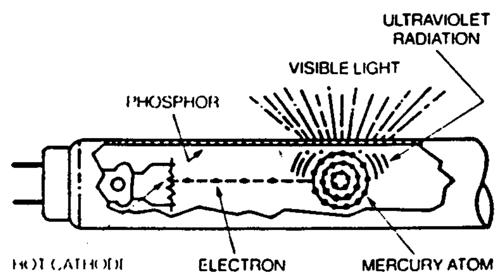

Figure 3

FLUORESCENT LIGHT AND UV EMISSIONS

The toxic effects of sunlight on lupus patients is well known. There was some concern about UV emission from fluorescent lamps, especially those patients with systemic lupus erythematosus (SLE). A small percentage of lupus patients that are particularly photosensitive to UV.

To verify that we are nor exacerbating the problem for the SLE patient with our fluorescent fixtures, we contracted with ETL Testing Laboratories, Inc., of New York to conduct a series of UV tests. The purpose was to determine if our patient care areas were being subjected to elevated levels of UV emissions from the fluorescent fixtures.

Spectral flux tests of the fluorescent fixtures with and without acrylic lenses were conducted with an Optronics Spectroradiometer with ultraviolet region gratings and ETL Integrating Sphere Photometer. The fixture was

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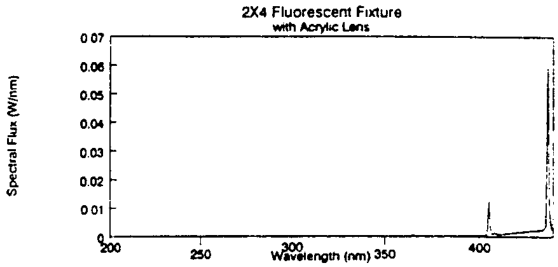
measured spectrally with the acrylic lens installed in the sunbed and then without the acrylic lens in place. The two series of spectral measurements were taken at one nm intervals. Measurements were taken with the fixture suspended at the center of the ETL Sphere Photometer. The electronic ballast in the fixture was operated at 277 volts. It powered three 4-foot T-8 fluorescent lamps for the series of tests.



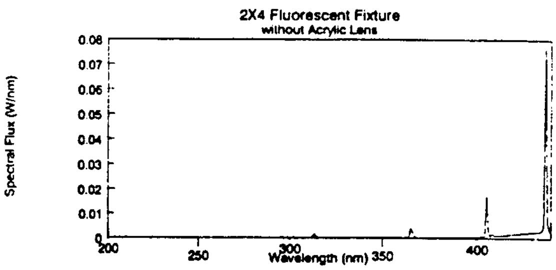


Figure 4

The UV-C integration values were obtained by the summations of the spectral irradiance values from 200 to 260 nm for each test. UV-B integration values were obtained by the summations of the spectral irradiance values from 260 to 320 nm for each test. UV-A integration values were obtained by the summations of the spectral irradiance values from 320 to 400 nm for each test. UV-C to UV-B ratio was computed from the UV-C and UV-B integration values for each test. UV-B to UV-A ratio was computed from the UV-B and UV-A integration values for each test.

The first test was conducted using a three lamp fixture with a Magnetek electronic ballast with acrylic lens, and the second test was performed without acrylic lens as shown in figure 4. Results indicate that there appears to be no significant ultraviolet emissions produced by fluorescent fixtures typically used in an office or medical environment. Therefore, there is no potential for adverse effects for lupus patients, or health risks for the general public.

LIGHTING; A MEDICAL TREATMENT

In July 1993 a scientific study was conducted by Dr. Hugh McGrath, Section of Rheumatology, Department of Medicine, Louisiana State University Medical Center in New Orleans. That study involved fifteen patients with SLE. Results using special fluorescent lamps to obtain only UV-A1 (340-400 nm) and visible light emissions, produced significantly diminished clinical disease activity and autoantibodies. Four patients selected for long term therapy (8-months) improved further over time.

Joint pain, fatigue, morning stiffness, malaise, headache, disturbed sleep pattern, impaired activity level and need for pain medication all decreased dramatically with treatment. There were no side effects. Since exposure was in the UV-A1 range there was no observed tanning. Two of these patients had a positive noteworthy response. One had a rash over the entire upper torso that was resistant to several months of extensive corticosteroid therapy. Using UV-A therapy for three days eliminated the pruritic (relating to itching) symptoms. A resolution of up to 70 percent of the symptoms was realized after three weeks of therapy. The rash reestablished itself after the phototherapy was discontinued.

A PRESCRIPTIVE CONTROL OF LIGHT

There are several ways to control light in a given application. Light fixtures can be designed to control light distribution for a variety of applications. Manufacturers employ one or more of the following in the design elements of a lighting fixture:

- absorption
- diffraction
- diffusion
- polarization
- reflection
- refraction

Painted reflectors produce a diffuse light and are typically found in standard off-the-shelf fluorescent fixtures. They use multiple lamps to produce enough lumens (if properly applied) to illuminate the work surface. Painted surface reflectors and other similar materials reflects at all angles while exhibiting little directional control. Pigment in the paint is composed of minute pigment particles which tend to reflect diffuse light as illustrated in figure 5. Some of this light is lost in the fixture.

The highly reflective specular surface of a fluorescent reflector is typically made of a polished aluminum, silver film or dielectric film. Proper design will control light reducing light loss within the fixture. Energy gains are achieved by removing one-half of the lamps and

LT4-30

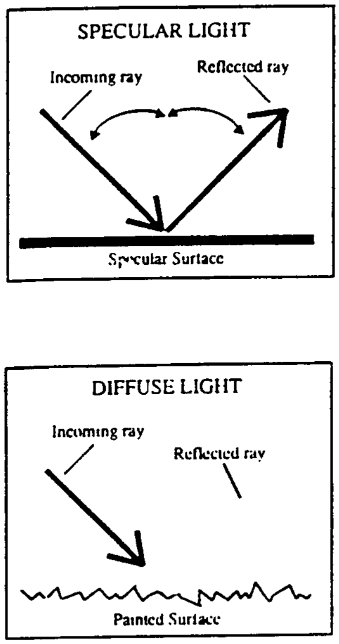


Figure 5

repositioning the remaining lamps in the center of each side of the fixture. The reflector produces multiple images of the relocated lamps, making the fixture appear to have all the lamps still inside. Without image (light) control, additional lights must be added to make-up for light loss within the fixture.

Fluorescent fixtures are inherently inefficient at getting the light out of the fixture, (no optical control). Light typically bounces around inside the fixture. Using the specular optical reflector allows for control of light and therefore reduction in a total number of lamps and ballasts. Maintenance costs are reduced as well as energy consumption.

The success of a lighting project incorporating specular optical reflectors totally depends on design by the manufacturer. Reflectors cannot be a single universal design but must be designed for each specific application. The goal is to reflect light directly out of the fixture and create a spread (horizontal illuminance) of light necessary for the particular application. It should create multiple reflections without directing the light back onto the lamp. In some cases, this can shorten the life of the lamp. Our requirements are that the design include a curved profile with a series of bends for multiple images.

Long-term performance of the reflector material is of utmost importance. Any degradation of the specular surface material during the life of the system will affect the fixture's long-term performance. This is understandable when the material is oxidized, improperly applied or scratched either before, during or after the manufacturing process. Most manufacturers do not guarantee their product beyond a few years (generally five years or less). Some manufacturers guarantee the reflector material will not degrade over a 25-year period.

As of October 1994, the Southern California Region has removed over 31,000 fluorescent lights and 19,000 ballasts from operation. Savings are realized by not having to own, operate and maintain these lamps and ballasts. Our goal is to remove 100,000 fluorescent lamps from operation through the application of specular optical reflectors. All lamps removed during our lighting project are recycled.

Our lighting systems also impact heating loads in our facilities. Therefore, another advantage of removing lights and ballasts is air-conditioning costs decrease. This is due to less heat generated within the building envelope.

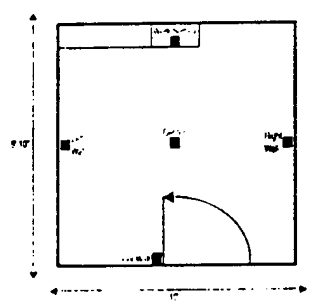
THE FONTANA CASE STUDY

I. Introduction

To test the efficacy of our prescriptive measures for lighting, we randomly selected a patient care room in a medical office building located in Fontana, California. The following case study is the results of our investigation.

Date of Test August 26, 1994
Measurement Equipment Sylvania DS-2000 Calibrated Light Meter (in footcandles)
Room 3032 - Phase 5
Room Size 10 X 9'10"
Ceiling Height 9'
Windows No – no ambient light
Work surface height 36"
Room Layout (not to scale) with 5 testing points indicated

Figure 6



The lighting test of a typical 2x4 fixture was conducted in 1994. Figure 6 shows the room and testing information. It also gives further specific detail including the testing criteria sheet that gives specific testing protocol followed during the test. One additional test, designated B-1, was included at the time of test. Room 3032 in Phase 5, an exam room, was chosen because it had one 4-lamp 2x4 layin troffer with A12 diffuser and no ambient light. Phase 5 of the hospital was opened in 1989, making the fixture about 4 to 5 years old.

II. Purpose

The purpose of the test was to demonstrate:

- Washing fixtures does not increase efficiency of the fixture significantly in a typical hospital setting. Further, fixture washing alone is not justified as the sole method for delamping fixtures during lighting retrofit projects.

- Ballast and lamp changeouts (BLO) (after washing the fixture) are valid in some configurations.

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- Whether or not delamping fixtures and adding specular optical reflectors is the most viable option for the majority of 2x4 fixture retrofits in terms of providing equivalent or better light while providing maximum value to the organization.

III. Existing Condition (Test A)

As tested, the fixture in the exam room did not produce adequate light at the work surface (36 inches) to meet the Illuminating Engineering Society (IES) "E" standard (50-75-100 footcandles) for exam rooms (local). The fixture had 4 Sylvania F40LWSS 34 Watt lamps and two Velmont 861038W Maxi Miser II 277 volt ballasts. The test measured 44 footcandles at the work surface. Test A was used as the baseline for comparison.

IV. Fixture Washing (Test B, B-1,C and D)

Test B was conducted in the same configuration as test A. The fixture was washed, the 4 original 34 watt lamps were placed back in the fixture and measurements taken. The efficiency of the fixture increased at the work surface by 4.3% and overall by 3.0%. This increase still did not bring the light levels up to the IES standard for an exam room. Washing the fixture alone is not effective for retrofit projects because the cost to wash the fixture is not offset by any energy/cost savings.

Test C and D further demonstrate that washing and reducing lamps and replacing existing 34 watt lamps is not applicable. The average efficiency of the fixtures decreased by 36.4% for a washed fixture delamped to 3 lamps (Test C) and by 80.9% for a washed fixture delamped to 2 lamps (Test D).

Test B-1 was done with 4 new Sylvania F40T12/D35 40 watt lamps and the original Velmont ballasts from Test A after the fixture was washed. The average efficiency increase was 38.5% . The reading at the work surface was 71 footcandles and meets the IES standard for an exam room. The significant factor was the lamp change, not the fixture washing. It should be noted that 40 watt fluorescent lamps were probably the original lamps installed in the fixtures in that room.

V. Ballast and Lamp Only (BLO) Changeouts (Tests E, F and G)

Test E was conducted with the washed fixture and installing 4 Sylvania Octron FO32835 32 watt 3500K T8 lamps and two Magnetek B232I277RH electronic ballasts. The results of this changeout were almost identical to Test B-1 where 4 new 40 watt T12 lamps were installed. This shows that a 4 lamp BLO with 4 T8 lamps and electronic ballasts is effective for retrofits in exam rooms, offices, acute care patient areas and other areas requiring an "E" IES illuminance category (50-75-100 footcandles). There are some energy savings for this retrofit due to the reduced wattage of the lamps from 34 watts to 32 watts and the reduced load of electronic ballasts.

Test F reduced the 4 T8 lamps to 3 T8 lamps in the washed fixture using the two Magnetek ballasts from Test E. The test fixture used had a very shallow ballast cover so the light was evenly distributed throughout the exam room. In most cases the ballast cover is deeper (2" to 3") and the light will be unevenly distributed in the room. One half of the room will be underlit. This is not an acceptable BLO application for retrofits.

Test G went from 4 T8s to 2 T8s in the washed fixture using one Magnetek electronic ballast from Test E. This configuration does not come close to the original baseline fixture (Test A). The average efficiency reduction was 22.9%. Footcandles at the work surface were 36, compared to 44 from the baseline fixture. It would be useful only in areas that are overlit such as storage or corridors. Our experience shows that 2-lamp T8 BLOs have very limited application, but can be used for retrofits. The energy savings are about 50% for these changeouts.

VI. Ballast and Lamp Changeouts with Specular Optical Reflectors (Tests H and I)

Test H was conducted with 3 of the T8 lamps and the Magnetek ballasts from Test E, with an electropolished aluminum specular optical reflector installed. This configuration compares favorably with Test B-1 and E. It outperforms the 4-lamp T8 32 watt configuration at the center, with a 1% increase. Both 4 lamp configurations (40 and 32 watt) at the work surface measured 71 footcandles. The 3-lamp T8 with reflector configuration measured 67 footcandles, or a difference of 3.7% at the work surface. All three meet the IES standard for an exam room. The 3-lamp T8 with reflector retrofit is one recommended configuration because it provides acceptable light level while realizing an additional 25% energy cost savings over the 4 lamp T8 BLO.

Test I measured the efficiency of having half the lamps of the 4-lamp T8 BLO and a specular optical reflector. The 2-lamp T8 with reflector configuration was closest to achieving the light levels of the baseline fixture (Test A). It would not be adequate to meet IES standards for exam rooms, offices and acute care patient areas needing between 50 to 100 footcandles. It would be adequate for general service are as such as stairways, corridors, appointment areas, lobbies, waiting areas and dining areas for example. These areas need between 10 and 50

footcandles. The energy savings are about 50% for these changeouts.

VII. Conclusion and Cost Comparison - BLO Changeouts Compared to Ballast and Lamp Changeouts with Reflectors

The actual retrofit cost from the Kaiser Permanente Riverside Park Sierra MOB lighting retrofit project completed in July 1994 was used as the basis for this comparison. At issue is whether lighting retrofits with reflectors work and provide value to the organization. The results of the testing show that reflectors work and the attached cost comparisons show the following:

- The actual increased installed cost per fixture for a 3-lamp T8 with reflector retrofit changeout instead of a 4-lamp T8 BLO is $8.01. This incremental increased cost is recovered in energy and life cycle costs in 8.6 months.

- The estimated incremental additional savings from using reflectors in 2x4 fixtures for the Fontana Lighting Project is $123,000+ a year. Over 10 years this adds up to an additional savings of $1.23 million dollars. This provided ample justification for installation of specular optical reflectors in retrofit applications.

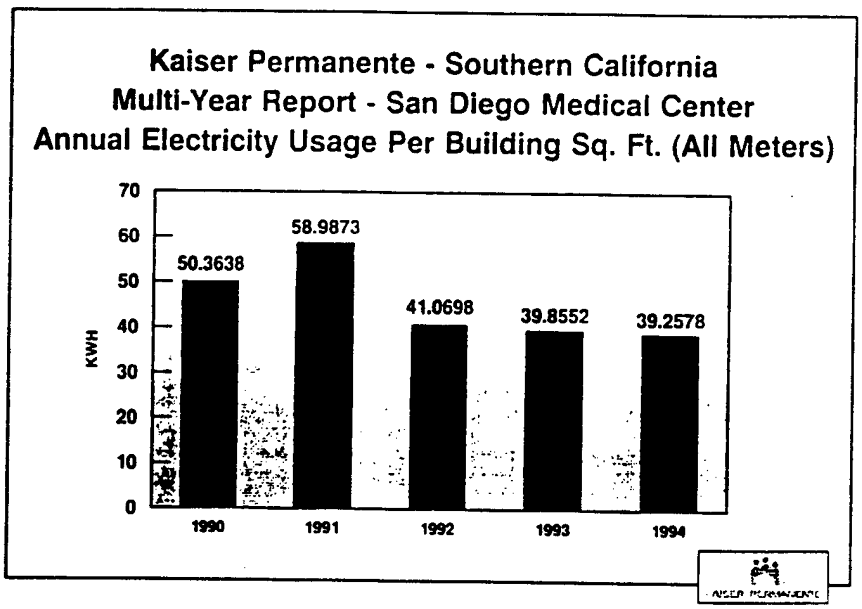

Figure 7

SAN DIEGO; TWO YEARS LATER

The lighting project in San Diego includes 13 buildings and a medical center was completed at the end of December 1992. Figure 7 is a five year report showing the KWh consumption per building square foot since 1990. The kilowatt-hour (KWh) usage per square foot dropped 27 percent in 1993 and 28 percent in 1994 from previous years. It is interesting to note that the San Diego area had record-breaking high temperatures and humidity during the summer of 1992.

Two years after completing the project, we returned to take light meter readings. Figure 8 are the results of those readings.

ANAHEIM RESULTS

The lighting retrofit project at our Anaheim Medical Center was completed in December 1993. The annual average KWh usage per square foot for 1990 through 1992 was 41.0827 KWh per square foot and it decreased to 31.2827 KWh per square foot after the project in 1994 (figure 9). This was a 23.85 percent reduction in KWh per square foot.

Last year we returned to take additional light meter readings on selected rooms. Figure 10 are the results of those readings.

KAISER PERMANENTE ENERGY SERVICES
FOOTCANDLE COMPARISON REPORT

BEFORE LIGHTING RETROFIT AND TWO YEARS AFTER RETROFIT

SITE: SAN DIEGO MEDICAL CENTER, 4647 ZION AVE.
USING: CALIBRATED SYLVANIA IDS-2000 LIGHT METER
READ DATE: AUGUST 1, 1994
BY: VIRGINIA PRUE, CEM
JENNY FLACK, IL&S

ROOM NO.	AREA	FIXTURE TYPE	REFLECTOR (YES OR NO)	PREV. READ DATE	IES STANDARD (FC)	PREVIOUS FC READING	CURRENT F READING
5319	PANTRY	A	YES	6-25-92	D (20-30-50)	91	60
5300	NURSES STATION	X-A2K	NO	6-25-92	E (50-75-100)	70	74
5228	OFFICE (NO TASK LIGHTING INCL.)	X-A5	YES	6-25-92	D (20-30-50)	41-53	48-51
4404	SPEC. CARE NURSERY (DIMMER)	A	YES	6-25-92	C (10-15-20)	18-38	44-80
	IN INDIVIDUAL BASSINETS:						
	WITH EXAM LIGHTING				E (50-75-100)		165
	WITH TASK LIGHTING				H (500-750-1000)		1800
3228	CHAPLAIN'S OFFICE	X-A4	YES	6-23-92	D (20-30-50)	65	58-64
2426	SATELLITE PHARMACY (HOME IV)	X-A2K	NO	6-30-92	E (50-75-100)	69-86	68-99
2102	PATIENT ROOM (ACUTE CARE) ONCOLOGY 2-WEST	X-A4K	YES	6-30-92	E (50-75-100)	114	154
2128	PATIENT ROOM (ACUTE CARE ONCOLOGY 2-WEST	X-A4K	YES	7-9-92	E (50-75-100)	132	142
2128	PATIENT ROOM BATHROOM ONCOLOGY 2-WEST	X-BB	YES	7-9-92	D (20-30-50)	34	37
3103	CRITICAL CARE CNICU	X-A4KD	YES	7-9-92	E (50-75-100)	142	156

• SEE ATTACHED FIXTURE SCHEDULE FOR DEFINITION (BEFORE AND AFTER)

Figure 8

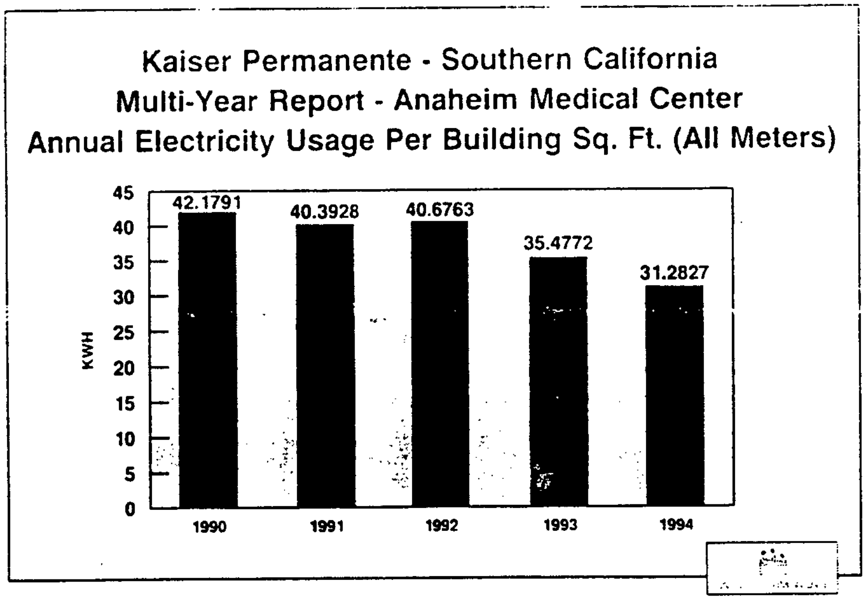

Figure 9

LT4-34

KAISER PERMANENTE ENERGY SERVICES

SITE: ANAHEIM MEDICAL CENTER, 441 N. LAKEVIEW AVE.
USING: CALIBRATED SYLVANIA DS-2000 LIGHT METER

FOOTCANDLE COMPARISON REPORT
BEFORE LIGHTING RETROFIT AND TWO YEARS AFTER RETROFIT

READ DATE: SEP. 9, 1994 & (APR. 13, 1995, OR ROOM)
BY: VIRGINIA PRUE, CEM
JENNY FLACK, IL&S

ROOM NO.	AREA	FIXTURE TYPE	REFLECTOR (YES OR NO)	PREV. READ DATE	IES STANDARD (FC)	PREVIOUS FC READING	CURRENT FC READING
B01	FOOD PREP	A/3	YES	3-19-93	50	77,122,108	E(50-75-100)
B06	OFFICE (NO TASK LIGHTING INCL.)	A/2	NO	3-19-93	77	77	D(20-30-50)
SPD	PREP AREA-CTRL STERILE SUPPLY	A/3	YES	3-19-93	53	107,124	E(50-75-100) F(100-150-200)
W108	CHART ROOM-MEDICAL RECORDS IES NOT COMPARABLE, READS AT FLOOR, NOT TASK HEIGHT	A/3	YES	3-19-93	14	24,25,23	E(50-75-100) SEE NOTE AT LEFT
ER	NURSES STATION	A/3	YES	3-19-93	73	111	E(50-75-100)
ICU SO.	NURSES STATION	A	YES	3-23-93	66-71	98,103,134	E(50-75-100)
WAS 122 NEW 1322	OFFICE (NO TASK LIGHTING INCL.)	A/3	YES	3-23-93	50	72-79	D(20-30-50)
WAS 120 NEW 1320	OFFICE (NO TASK LIGHTING INCL.)	A/3	YES	3-23-93	51	61,70	D(20-30-50)
2ND FLR	IV AREA LITE-INPATIENT PHARM	A/3	YES	3-23-93	68-100	73-107	E(50-75-100)
2ND FLR	INPATIENT PHARMACY	A/3	YES				
	FLOOR				39	51,54,58	
	COUNTER				65	80,93	E(50-75-100)
OR4	OPERATING ROOM-GENERAL	A6/L	YES	3-19-93	133-241	151-241	F(100-150-200)

• SEE ATTACHED FIXTURE SCHEDULE FOR DEFINITION (BEFORE AND AFTER)

Figure 10

THE ENVIRONMENTAL BENEFITS

Traditionally, electrical and thermal energy is produced by a combustion process. Coal, fuel oil and natural gas are common fuels used for electrical generation at central power plants.

Health risks from polluted air are starting to be accepted as an actual cost for energy. Some of these costs are starting to manifest themselves in the form of higher energy costs. Air pollution, higher maintenance and energy costs are the driving forces behind Kaiser Permanente's switch to more energy-efficient lighting. Energy-efficient lighting makes good economic sense.

According to the California Energy Commission and the Environmental Protection Agency, our greatest resource is energy conservation.

In our resource planning, we are removing 1/3 to 1/2 of the lamps used in our facilities by using specular optical reflectors. When we removed over 31,000 fluorescent lamps and 19,000 ballasts from operation, it also meant we reduced source emissions. This annually translates into emission reductions of:

- 5,430 Tons of CO_2
- 13 Tons of SO_2
- 18 Tons NO_X
- 17,370 Barrels of oil

With a $40 million dollar energy budget, performing a lighting project in Southern California will reduce our cost of operation by almost $10 million dollars. The cost of lighting of our hospitals exceeds 40% of the total cost of electricity. Reducing those cost by 50% yields about a 20% reduction in electric consumption for the facility.

CONCLUSION

After extensive testing and actual results from our comprehensive lighting retrofit projects, we have developed a successful systems approach for our medical centers. The evidence supports our belief that quality lighting and energy efficiency can be successfully implemented together, while also being environmentally responsible.

REFERENCES

Figure 1 Energy Services, Kaiser Permanente, Southern California Region

Figure 2 Sylvania Engineering Bulletin 0-341

Figure 3 Sylvania Engineering Bulletin 0-341

Figure 4 ETL Testing Laboratories, Inc. Report #541395 July 25, 1994

Figure 5 Energy Services, Kaiser Permanente, Southern California Region

Figure 6 Energy Services, Kaiser Permanente, Southern California Region, September 1994

Figure 7 Audio Visual Services and Energy Services, Kaiser Permanente, Southern California Region, February 1995

Figure 8 International Lighting & Services, San Diego and Energy Services, Kaiser Permanente, Southern California Region, September 1994

Figure 9 Audio Visual Services and Energy Services, Kaiser Permanente, Southern California Region, February 1995

Figure 10 International Lighting & Services, San Diego and Energy Services, Kaiser Permanente, Southern California Region, September 1994

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VISION 2001: ENERGY & ENVIRONMENTAL ENGINEERING

PROCEEDINGS OF THE
18TH WORLD ENERGY ENGINEERING CONGRESS
ENVIRONMENTAL TECHNOLOGY EXPO
PLANT & FACILITIES EXPO
NOVEMBER 8-10, 1995
GEORGIA WORLD CONGRESS CENTER
ATLANTA, GEORGIA

aee®

EISENHOWER AMC
FT. GORDON, GA

SCREENING CALCULATIONS
OCCUPANCY SENSORS — ECO # MI3
FILENAME: OSENS.WK4

RESTROOMS ECO MI3A

# 2L FIXTS	KW	ENERGY USE (KWH) CURR.	PROP'D	ANNUAL SAVINGS (KWH)	($)	SIMPLE PAYBACK (YRS)
1	0.058	507	253	253	$6.59	25.2
2	0.116	1,013	507	507	$13.17	12.6
3	0.174	1,520	760	760	$19.76	8.4
4	0.232	2,027	1,013	1,013	$26.35	6.3
5	0.290	2,533	1,267	1,267	$32.93	5.0
6	0.348	3,040	1,520	1,520	$39.52	4.2

Assumptions:

Electricity avg. rate=	$0.026 c/kwh
Cost=	$166
Operating hrs=	168 hrs/wk
Proposed op hrs =	84.0 hrs/wk
Percent savings =	50%

BREAKROOMS MI3B

# 2L FIXTS	KW	ENERGY USE (KWH) CURR.	PROP'D	ANNUAL SAVINGS (KWH)	($)	SIMPLE PAYBACK (YRS)
1	0.058	507	63	443	$11.53	14.4
2	0.116	1,013	127	887	$23.05	7.2
3	0.174	1,520	190	1,330	$34.58	4.8
4	0.232	2,027	253	1,773	$46.11	3.6
5	0.290	2,533	317	2,217	$57.64	2.9
6	0.348	3,040	380	2,660	$69.16	2.4

Assumptions:

Electricity avg. rate=	$0.026 c/kwh
Cost=	$166
Operating hrs=	168 hrs/wk
Proposed op hrs =	21.0 hrs/wk
Percent savings =	88%

OFFICES MI3C

# 2L FIXTS	KW	ENERGY USE (KWH) CURR.	PROP'D	ANNUAL SAVINGS (KWH)	($)	SIMPLE PAYBACK (YRS)
1	0.058	151	124	27	$0.71	80.8
2	0.116	302	247	54	$1.41	40.4
3	0.174	452	371	81	$2.12	26.9
4	0.232	603	495	109	$2.82	20.2
5	0.290	754	618	136	$3.53	16.2
6	0.348	905	742	163	$4.23	13.5

Assumptions:

Electricity avg. rate=	$0.026 c/kwh
Cost=	$57
Operating hrs=	50 hrs/wk
Proposed op hrs =	41.0 hrs/wk
Percent savings =	18%

EXAM ROOMS MI3D

# 2L FIXTS	KW	ENERGY USE (KWH) CURR.	PROP'D	ANNUAL SAVINGS (KWH)	($)	SIMPLE PAYBACK (YRS)
1	0.058	151	60	90	$2.35	24.2
2	0.116	302	121	181	$4.70	12.1
3	0.174	452	181	271	$7.06	8.1
4	0.232	603	241	362	$9.41	6.1
5	0.290	754	302	452	$11.76	4.8
6	0.348	905	362	543	$14.11	4.0

Assumptions:

Electricity avg. rate=	$0.026 c/kwh
Cost=	$57
Operating hrs=	50 hrs/wk
Proposed op hrs =	20.0 hrs/wk
Percent savings =	60%

CONSTRUCTION COST ESTIMATE

Project:	ECO # MI3A Install Occupancy Sensors in Restrooms	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/8/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTMI3A.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Occupancy Sensor,	100	ea	$56.11	$5,611	$33.50	$3,350	$8,961	Dp61,107	MEp239
ceiling mounted									
Power pack	100	ea	$17.54	$1,754	$23.50	$2,350	$4,104	Dp61,107	MEp239
Mounting bracket	100	ea	$2.45	$245			$245	Dp61,107	
Subtotal Bare Costs				$7,610		$5,700	$13,310		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$7,610		$5,700	$13,310		
City Cost Index (Aug. GA)			0%	$0	-46%	($2,622)	($2,622)	MMp533	MMp533
				-		-	-		
Subtotal				$7,610		$3,078	$10,688		
OH & Profit Markups			10%	$761	53%	$1,631	$2,392	MMp7	MMp475
				-		-	-		
Subtotal				$8,371		$4,709	$13,080		
Sales Taxes			6.0%	$502		NA	$502	MMp476	
				-		-	-		
Subtotal				$8,873		$4,709	$13,582		
Contingency			10%	$887	10%	$471	$1,358	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$9,760		$5,180	$14,940		
Design Fee				NA	6.0%	$815	$815		
SIOH				NA	6.0%	$815	$815		
				-		-	-		
Total Project Cost				$9,760		$6,810	$16,570		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: MI3
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-MI3 INSTALL OCCUPANCY SENSORS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION A - RESTROOMS
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 14900.		
B. SIOH	$ 894.		
C. DESIGN COST	$ 894.		
D. TOTAL COST (1A+1B+1C)	$ 16688.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 16688.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	259.	$ 1974.	13.68	$ 26999.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		259.	$ 1974.		$ 26999.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 1974.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.46 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 26999.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.62
(IF < 1 PROJECT DOES NOT QUALIFY)

MI3-2a

RS&H

SUBJECT ______________________ AEP NO ______________

______________________ SHEET ______ OF ______

DESIGNER ______________________ DATE ______________

CHECKER ______________________ DATE ______________

ECO MI3B Occupancy Sensors in Breakrooms

Other similar rooms include:
lounges, kitchens, conference rooms, utility rooms, janitors' closet, etc.

Total Load = 38.3 kW (see spreadsheet)
Operating hours = 168 hrs/wk
Proposed op hrs = 21 hrs/wk

Savings = $(168-21)$ hr/wk $\times$ $\frac{52 \text{ wk}}{\text{yr}}$ $\times$ 38.3 kW = 292,765 kwh

= 999 MBtu/yr.

FT. GORDON EISENHOWER ARMY MEDICAL CENTER

SURVEY OF LIGHTS FOR INSTALLING OCCUPANCY SENSORS

ROOM #	ROOM DESCRIPTION	# FLUOR. 'U' L FIX.	# FLUOR. 8 L FIX.	# FLUOR. 4 L FIX.	# FLUOR. 2 L FIX.	# FLUOR. 1 L FIX.	# SWITCHES
1B-03	EXAMINATION ROOM			2			1
1B-06	EXAMINATION ROOM			2			1
1B-08	EXAMINATION ROOM			2			1
1B-10	EXAMINATION ROOM			2			1
1B-13	EXAMINATION ROOM			2			1
1B-15	EXAMINATION ROOM			2			1
1B-17	EXAMINATION ROOM			2			1
1B-19	EXAMINATION ROOM			2			1
1B-21	EXAMINATION ROOM			2			1
1B-27	EXAMINATION ROOM			2			1
1B-30	EXAMINATION ROOM			2			1
1B-33	EXAMINATION ROOM			2			1
1B-44	EXAMINATION ROOM			2			1
1B-51	EXAMINATION ROOM				4		1
1B-54	EXAMINATION ROOM				2		1
1D-04	EXAMINATION ROOM			2			1
1D-08	EXAMINATION ROOM			2			1
1D-11	EXAMINATION ROOM			2			1
1D-12	EXAMINATION ROOM			2			1
1D-15	EXAMINATION ROOM			2			1
1D-18	EXAMINATION ROOM			2			1
1D-20	EXAMINATION ROOM			2			1
1D-21	X-RAY EXAM. RM			2			1
1D-22	EXAMINATION ROOM			2			1
1D-24	EXAMINATION ROOM			2			1
1D-27	EXAMINATION ROOM			2			1
1D-29	EXAMINATION ROOM			2			1
1D-31	EXAMINATION ROOM			2			1
1D-35	EXAMINATION ROOM			2			1
1D-57	EXAMINATION ROOM			2			1
1D-59	EXAMINATION ROOM			2			1
1D-68	EXAMINATION ROOM			2			1
1E-05	EXAMINATION ROOM			2			1
1J-24	BREAK ROOM				1		1
1L-17	BREAK ROOM		3				1
FP003	EXAMINATION ROOM			2			1
FP005	EXAMINATION ROOM			2			1
FP006	EXAMINATION ROOM			2			1
FP007	EXAMINATION ROOM			2			1
FP008	EXAMINATION ROOM			2			1
FP009	EXAMINATION ROOM			2			1
FP010	EXAMINATION ROOM			2			1
FP018	EXAMINATION ROOM			2			1
FP019	EXAMINATION ROOM			2			1
FP020	EXAMINATION ROOM			2			1
FP021	EXAMINATION ROOM			2			1
FP022	EXAMINATION ROOM			2			1
FP023	EXAMINATION ROOM			2			1
FP029	EXAMINATION ROOM			2			1
FP030	EXAMINATION ROOM			2			1
FP031	EXAMINATION ROOM			2			1
FP032	EXAMINATION ROOM			2			1
FP033	EXAMINATION ROOM			2			1
FP034	EXAMINATION ROOM			2			1
FP043	EXAMINATION ROOM			2			1
FP044	EXAMINATION ROOM			2			1
FP045	EXAMINATION ROOM			2			1
FP046	EXAMINATION ROOM			2			1
FP047	EXAMINATION ROOM			2			1
FP048	EXAMINATION ROOM			2			1
FP056	SOILED UTILITY RM				2		1
FP059	EXAMINATION ROOM			2			1
FP060	EXAMINATION ROOM			2			1
FP061	EXAMINATION ROOM			2			1
FP062	EXAMINATION ROOM			2			1
FP063	EXAMINATION ROOM			2			1
FP064	EXAMINATION ROOM			2			1
FP069	EQ. ST./LINEN/CL. U.				3		1
FP075	EXAMINATION ROOM			2			1
FP076	EXAMINATION ROOM			2			1
FP077	EXAMINATION ROOM			2			1
FP078	EXAMINATION ROOM			2			1
FP079	EXAMINATION ROOM			2			1
FP080	EXAMINATION ROOM			2			1
FP116	CONFERENCE ROOM				8		1
FP118	R/R & LOCKER RM				4		1
FP119	R/R & LOCKER RM				4		1
FP121	STAFF LOUNGE				2		1
FP129	STUDENT ROOM				6		1

MI3-3a

ROOM #	ROOM DESCRIPTION	# FLUOR 'U' L FIX.	# FLUOR 8 L FIX.	# FLUOR 4 L FIX.	# FLUOR 2 L FIX.	# FLUOR 1 L FIX.	# SWITCHES
2B-02	EXAMINATION ROOM			2			1
2B-04	EXAMINATION ROOM			2			1
2B-06	EXAMINATION ROOM			2			1
2B-08	EXAMINATION ROOM			2			1
2B-10	EXAMINATION ROOM			2			1
2B-13	STAFF LOUNGE			2			1
2B-19	EXAMINATION ROOM			2			1
2B-21	EXAMINATION ROOM			2			1
2B-22	UTILITY ROOM				2		1
2B-23	EQUIPMENT ROOM				2		1
2B-24	EXAMINATION ROOM			2			1
2B-26	EXAMINATION ROOM			2			1
2B-27	EXAMINATION ROOM			2			1
2B-29	EXAMINATION ROOM			2			1
2B-36	EXAMINATION ROOM			2			1
2B-40	KITCHEN			2			1
2B-XX	BREAK RM				2		1
2D-18	BREAK ROOM			1			1
2D-23	EXAMINATION ROOM			2			1
2D-26	EXAMINATION ROOM			2			1
2D-28	EXAMINATION ROOM			2			1
2D-30	EXAMINATION ROOM			2			1
2D-33	EXAMINATION ROOM			2			1
2D-35	EXAMINATION ROOM			2			1
2D-36	EXAMINATION ROOM			2			1
2D-38	EXAMINATION ROOM			2			1
2D-40	EXAMINATION ROOM			2			1
2D-41	EXAMINATION ROOM			2			1
2D-43	EXAMINATION ROOM			2			1
2D-45	EXAMINATION ROOM			2			1
2D-48	EXAMINATION ROOM			2			1
2D-50	EXAMINATION ROOM			2			1
2D-58	EXAMINATION ROOM			2			1
2D-60	EXAMINATION ROOM			2			1
2D-62	EXAMINATION ROOM			2			1
2E-07	EXAMINATION ROOM			3			1
2E-08	EXAMINATION ROOM			3			1
2E-09	EXAMINATION ROOM			3			1
2E-11	EXAMINATION ROOM			3			1
2E-12	BREAK ROOM				2		1
2E-21	EXAMINATION ROOM			3			1
2E-22	EXAMINATION ROOM			3			1
2E-23	EXAMINATION ROOM			3			1
2E-24	EXAMINATION ROOM			3			1
2F-12	EXAMINATION ROOM			2			1
2F-14	EXAMINATION ROOM			2			1
2F-17	EXAMINATION ROOM			2			1
2F-20	EXAMINATION ROOM			2			1
2F-21	EXAMINATION ROOM			2			1
2F-24	EXAMINATION ROOM			2			1
2F-25	EXAMINATION ROOM			2			1
2F-28	EXAMINATION ROOM			2			1
2F-29	EXAMINATION ROOM			2			1
2F-32	EXAMINATION ROOM			2			1
2F-33	EXAMINATION ROOM			2			1
2F-38	EXAMINATION ROOM			2			1
2F-39	EXAMINATION ROOM			2			1
2F-40	EXAMINATION ROOM			2			1
2G-06	EXAMINATION ROOM			2			1
2I-08	EXAMINATION ROOM			2			1
2I-10	EXAMINATION ROOM			2			1
2I-18	EXAMINATION ROOM			2			1
2I-20	EXAMINATION ROOM			2			1
2I-22	EXAMINATION ROOM			2			1
2J-05	EXAMINATION ROOM			2			1
2J-07	EXAMINATION ROOM			2			1
2J-12	EXAMINATION ROOM			2			1
2J-13	EXAMINATION ROOM			2			1
2J-15	EXAMINATION ROOM			2			1
2K-01	LOCKER ROOM	3					1
2K-05	LOUNGE				7		1
2N-05	EXAMINATION ROOM			2			1
2N-07	EXAMINATION ROOM			2			1
2N-08	EXAMINATION ROOM			2			1
2O-19	SUPPLY ROOM				2		1
2O-23	EXAMINATION ROOM			2			1
2O-25	EXAMINATION ROOM			2			1
2O-27	EXAMINATION ROOM			2			1
2O-34	BREAK ROOM				1		1
2O-50	CONFERENCE ROOM			6			1
2P-05	EXAMINATION ROOM			2			1
2P-07	EXAMINATION ROOM			2			1
2P-09	EXAMINATION ROOM			2			1
2P-11	EXAMINATION ROOM			2			1
2P-34	EXAMINATION ROOM			2			1
2P-36	EXAMINATION ROOM			2			1
2P-40	EXAMINATION ROOM			2			1
2P-42	EXAMINATION ROOM			2			1
2P-44	EXAMINATION ROOM			2			1
2Q-01	CONFERENCE ROOM				2		1
2R-25	PRINTER ROOM				4		1

MI3-36

ROOM #	ROOM DESCRIPTION	# FLUOR. 'U' L FIX.	# FLUOR. 8 L FIX.	# FLUOR. 4 L FIX.	# FLUOR. 2 L FIX.	# FLUOR. 1 L FIX.	# SWITCHES
3B-14	LOCKER ROOM				3		1
3B-17	LOCKER ROOM					8	1
3E-08	LOCKER ROOM				1		1
3F-03	LOCKER ROOM				1		1
3I-08	R/R & LOCKER RM				1		1
3I-11	PASSAGE TO LK RM				4		1
3I-12	LOCKER ROOM				2		1
3K-05	LOCKER ROOM				1		1
3K-23	LOCKER ROOM				1		1
3K-24	PASSAGE TO LOCKER				3		1
3K-25	LOUNGE				3		1
3K-26	LOCKER RM & SHOWER				3		1
3K-27	LOCKER ROOM				1		1
3K-29	PASSAGE TO LOCKER				3		1
3L-04	UTILITY RM				1		1
4C-12	BREAK ROOM				1		1
4C-18	CONFERENCE ROOM				10		1
5A-13	SOILED UTILITY ROOM				2		1
5A-14	CLEAN UTILITY ROOM				2		1
5A-18	MONIT. STORAGE RM				2		1
5A-19	UTILITY/EQUIP. STOR.				2		1
5B-17	COMPUTER ROOM				2		1
5B-40	CONFERENCE ROOM			4			1
5B-41	LOCKER ROOM				2		1
5C-37	KITCHEN			1			1
5C-38	SUPPLY ROOM			1			1
5C-44	KITCHEN			1			1
5B-03	WAITING AREA	2			4		1
6A-30	CONF./CLASS ROOM				4		1
6A-31	CONTROL ACCESS				6		1
6A-35	BREAK ROOM				6		1
6A-40	SCRUB				2		1
6A-49	SOILED UTILITY ROOM	3					1
6A-50	CLEAN UTILITY ROOM	3					1
6A-53	CLEAN UTILITY ROOM				2		1
6B-16	MICROSCOPE ROOM				4		1
6B-41	EXAMINATION ROOM				2		1
6B-43	LOCKER ROOM				3		2
6B-46	SUPPLY ROOM				2		1
6C-14	CONFERENCE ROOM				4		1
6C-21	UV LIGHT ROOM			1			1
6C-27	SOILED UTILITY ROOM				2		1
6C-28	CLEAN UTILITY ROOM				1		1
6C-39	KITCHEN			1			1
7A-01	CONFERENCE ROOM				4		1
7A-46	KITCHEN			1			1
7A-53	SOILED UTILITY ROOM				3		1
7A-54	STAFF LOUNGE				3		1
7B-06	WAITING AREA	2			8		2
7B-11	BREAK ROOM/LOUNGE			1	4		2
7C-45	SOILED UTILITY ROOM				3		1
7C-46	CLEAN UTILITY ROOM				3		1
7C-53	KITCHEN			1			1
8A-01	CONFERENCE ROOM				4		1
8A-46	KITCHEN			1			1
8A-53	SOILED UTILITY ROOM				3		1
8A-54	CLEAN UTILITY ROOM				3		1
8B-06	VISITORS' WAITING ROOM				6		2
8B-45	BREAK ROOM/LOUNGE			2			1
8C-45	SOILED UTILITY ROOM				3		1
8C-46	CLEAN UTILITY ROOM				3		1
8C-53	KITCHEN			1			1
9A-46	KITCHEN			1			1
9A-53	SOILED UTILITY ROOM				3		1
9A-54	CLEAN UTILITY ROOM				3		1
9B-06	VISITORS' WAITING ROOM				12		2
9B-40	BREAK RM/LOCKER				2		1
9C-45	SOILED UTILITY ROOM				3		1
9C-46	CLEAN UTILITY ROOM				3		1
9C-53	KITCHEN			1			1
10A-01	CONFERENCE ROOM				4		1
10A-46	KITCHEN			1			1
10A-53	SOILED UTILITY ROOM				3		1
10A-54	CLEAN UTILITY ROOM				3		1
10B-06	VISITORS' WAITING ROOM				6		2
10C-45	SOILED UTILITY ROOM				3		1
10C-46	BREAK ROOM				3		1
10C-51	PRINTER ROOM	2					1
10C-53	KITCHEN			1			1

MI 3-36

ROOM #	ROOM DESCRIPTION	# FLUOR. 'U' L FIX.	# FLUOR. 8 L FIX.	# FLUOR. 4 L FIX.	# FLUOR. 2 L FIX.	# FLUOR. 1 L FIX.	# SWITCHES	# LIGHTS ALWAYS ON	PICTURE #
11A-46	KITCHEN			1			1		
11A-47	STORAGE ROOM				1		1		
11A-53	SOILED UTILITY ROOM				3		1		
11A-54	CLEAN UTILITY ROOM				3		1		
11B-06	VISITORS' WAITING ROOM				8		2		
11B-16	SUPPLY ROOM				2		1		
11B-40	BREAK ROOM				2		1		
11C-21	CONFERENCE ROOM				4		1		
11C-45	SOILED UTILITY ROOM				3		1		
11C-46	CLEAN UTILITY ROOM				3		1		
11C-53	KITCHEN			1			1		
12A-42	KITCHEN				1		1		
12A-49	SOILED UTILITY ROOM				3		1		
12A-50	CHART ROOM				3		1		
12B-04	GROUP THERAPY ROOM				12		1		
12B-17	EXAMINATION ROOM			2			1		
12B-40	GROUP THERAPY ROOM				3		1		33
12C-44	KITCHEN			1			1		
12C-44	KITCHEN			1			1		
13A-43	KITCHEN			1			1		
13A-50	SOILED UTILITY ROOM				3		1		
13A-51	CLEAN UTILITY ROOM				3		1		
13B-04	WAITING AREA				11		1		
13B-14	EXAMINATION ROOM			2			1		
13C-43	KITCHEN			1			1		
13C-50	CLEAN UTILITY ROOM				2		1		
13C-52	SOILED UTILITY ROOM				2		1		
	TOTAL	15	3	339	323	8	283		
Totals	watts/fixture	90	360	180	90	45			
	kW	1.4	1.1	61.0	29.1	0.4			92.9
Exam Rooms									
	Fixtures	0	0	300	6	0	150		
	kW	0	0	54	0.54	0			54.5
	Breakrooms, kit, util, etc	15	3	39	317	8	127		
	kW	1.35	1.08	7.02	28.53	0.36			38.3

MI3-3C

CONSTRUCTION COST ESTIMATE

Project: ECO # MI3B Install Occupancy Sensors in Breakrooms
Location: Fort Gordon, GA
Basis: Schematic Design
Building: Eisenhower Army Medical Center

RS&H No.: 694-1331-005
Date: 7/1/96
Estimator: P. HUTCHINS
Filename: ESTMI3B.XLS

ITEM DESCRIPTION	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Occupancy Sensor, ceiling mounted	127	ea	$56.11	$7,126	$33.50	$4,255	$11,381	Dp61,107	MEp239
Power pack	127	ea	$17.54	$2,228	$23.50	$2,985	$5,213	Dp61,107	MEp239
Mounting bracket	127	ea	$2.45	$311			$311	Dp61,107	
Subtotal Bare Costs				$9,665		$7,240	$16,905		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$9,665		$7,240	$16,905		
City Cost Index (Aug. GA)			0%	$0	-46%	($3,330)	($3,330)	MMp533	MMp533
				-		-	-		
Subtotal				$9,665		$3,910	$13,575		
OH & Profit Markups			10%	$967	53%	$2,072	$3,039	MMp7	MMp475
				-		-	-		
Subtotal				$10,632		$5,982	$16,614		
Sales Taxes			6.0%	$638		NA	$638	MMp476	
				-		-	-		
Subtotal				$11,270		$5,982	$17,252		
Contingency			10%	$1,127	10%	$598	$1,725	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$12,397		$6,580	$18,977		
Design Fee				NA	6.0%	$1,035	$1,035		
SIOH				NA	6.0%	$1,035	$1,035		
				-		-	-		
Total Project Cost				$12,397		$8,650	$21,047		

LEGEND:

- MMp### 1996 Means Mechanical Cost Data, page ###.
- MEp### 1996 Means Electrical Cost Data, page ###.
- Gp### 1995 Grainger, page ###
- Dp### 2/94 DGSC Energy Efficient Lighting, page ###

MI3-3d

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: MI3
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-MI3 INSTALL OCCUPANCY SENSORS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION B - BREAKROOMS
ANALYSIS DATE: 07-01-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 19000.		
B. SIOH	$ 1140.		
C. DESIGN COST	$ 1140.		
D. TOTAL COST (1A+1B+1C)	$ 21280.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 21280.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	999.	$ 7612.	13.68	$ 104137.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		999.	$ 7612.		$ 104137.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 7612.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.80 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 104137.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 4.89
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 13.24 %

MI3-3e

CONSTRUCTION COST ESTIMATE

Project:	ECO # MI3C Install Wall Switch Occupancy Sensors	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	3/8/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTMI3C.XLS

ITEM DESCRIPTION	QUANTITY No.	QUANTITY Unit	MATERIAL/EQUIP $/Unit	MATERIAL/EQUIP Total	LABOR $/Unit	LABOR Total	TOTAL COST	SOURCE Material	SOURCE Labor
Occupancy Sensor, wall switch	100	ea	$44.42	$4,442	$9.75	$975	$5,417	Dp61,107	MEp239
Subtotal Bare Costs				$4,442		$975	$5,417		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$4,442		$975	$5,417		
City Cost Index (Aug. GA)			0%	$0	-46%	($449)	($449)	MMp533	MMp533
				-		-	-		
Subtotal				$4,442		$526	$4,968		
OH & Profit Markups			10%	$444	53%	$279	$723	MMp7	MMp475
				-		-	-		
Subtotal				$4,886		$805	$5,691		
Sales Taxes			6.0%	$293		NA	$293	MMp476	
				-		-	-		
Subtotal				$5,179		$805	$5,984		
Contingency			10%	$518	10%	$81	$599	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$5,697		$886	$6,583		
Design Fee				NA	6.0%	$359	$359		
SIOH				NA	6.0%	$359	$359		
				-		-	-		
Total Project Cost				$5,697		$1,604	$7,301		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: MI3
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-MI3 INSTALL OCCUPANCY SENSORS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION C - OFFICES
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT
A. CONSTRUCTION COST $ 6700.
B. SIOH $ 402.
C. DESIGN COST $ 402.
D. TOTAL COST (1A+1B+1C) $ 7504.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 7504.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	28.	$ 213.	13.68	$ 2919.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		28.	$ 213.		$ 2919.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 213.

5. SIMPLE PAYBACK PERIOD (1G/4) 35.17 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2919.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .39
(IF < 1 PROJECT DOES NOT QUALIFY)

MI3-4a

CONSTRUCTION COST ESTIMATE

Project:	ECO # MI3D Install Wall Switch Occupancy Sensors - Exam Rms	RS&H No.:	694-1331-005
Location:	Fort Gordon, GA	Date:	7/1/96
Basis:	Schematic Design	Estimator:	P. HUTCHINS
Building:	Eisenhower Army Medical Center	Filename:	ESTMI3D.XLS

ITEM DESCRIPTION	QUANTITY No.	Unit	MATERIAL/EQUIP $/Unit	Total	LABOR $/Unit	Total	TOTAL COST	SOURCE Material	Labor
Occupancy Sensor,	100	ea	$44.42	$4,442	$9.75	$975	$5,417	Dp61,107	MEp239
wall switch									
Subtotal Bare Costs				$4,442		$975	$5,417		
Retrofit Cost Factors			0%	$0	0%	$0	$0	MMp6	MMp6
				-		-	-		
Subtotal				$4,442		$975	$5,417		
City Cost Index (Aug. GA)			0%	$0	-46%	($449)	($449)	MMp533	MMp533
				-		-	-		
Subtotal				$4,442		$526	$4,968		
OH & Profit Markups			10%	$444	53%	$279	$723	MMp7	MMp475
				-		-	-		
Subtotal				$4,886		$805	$5,691		
Sales Taxes			6.0%	$293		NA	$293	MMp476	
				-		-	-		
Subtotal				$5,179		$805	$5,984		
Contingency			10%	$518	10%	$81	$599	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$5,697		$886	$6,583		
Design Fee				NA	6.0%	$359	$359		
SIOH				NA	6.0%	$359	$359		
				-		-	-		
Total Project Cost				$5,697		$1,604	$7,301		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.
Gp###	1995 Grainger, page ###
Dp###	2/94 DGSC Energy Efficient Lighting, page ###

MI3-5

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: MI3
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-MI3 INSTALL OCCUPANCY SENSORS
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION D - EXAM ROOMS
ANALYSIS DATE: 07-01-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 6600.		
B. SIOH	$ 396.		
C. DESIGN COST	$ 396.		
D. TOTAL COST (1A+1B+1C)	$ 7392.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 7392.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	62.	$ 472.	13.68	$ 6463.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	0.	$ 0.	17.25	$ 0.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		62.	$ 472.		$ 6463.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	12.90	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 472.

5. SIMPLE PAYBACK PERIOD (1G/4) 15.65 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 6463.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .87
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 3.90 %

RS&H

SUBJECT Eisenhower AMC,

DESIGNER Fallon

CHECKER

AEP NO

SHEET OF

DATE 3/8/96

DATE

ECO # MI 14 NAT. GAS DESICCANT COOLING.

SEE ATTACHED ENGINEERED AIR SYSTEM'S LETTER of 2/29/96

LOAD ANALYSIS

SEE LETTER

BOILER CYCLE EFFICIENCY: $\eta = 0.80$ (New boiler as part of Renovation Project)

CONVENTIONAL SYSTEM.

ADJUST VENDOR CALC.S FOR CURRENT AIR FLOW — 32,000 CFM

COOLING

SENSIBLE

$(94-50)$ F x 32,000 CFM x 1.08 = 1.52 MB/HR

1.52 MBTU/HR x 1 TON/12000 BTU = 126 TONS.

LATENT

$(100-55)$ grains x 32,000 cfm x 0.68 = 0.979 MB/HR

0.979 MB/HR x 1 TON/12,000 B/HR x 10^6 = 81.6 TONS

TOTALS AT PEAK DESIGN

$(1.52 + 0.979)$ MBTU = 2.5 MBTU/HR

$(126 + 81.6)$ TONS = 207.6 TONS

ELECTRICAL ENERGY

207.6 TONS x 0.7 KW/TON = 145.3KW

REHEAT

$(65-50)$ x 32,000 CFM x 1.08 = 518,000 B/HR

NAT. GAS. CONSUMPTION 518,000 ÷ 0.80 = 647,500 Btu/hr

RS&H

SUBJECT		AEP NO	
		SHEET	OF
DESIGNER	FALLON	DATE	3/8/96
CHECKER		DATE	

DESICCANT SYSTEM

NAT. GAS USE

$$\frac{1{,}250{,}000 \text{ B/HR}}{0.80} = 1{,}562{,}500 \text{ B/Hr.}$$

COOLING (SENSIBLE ONLY)

(90 - 65) x 32,000 CFM x 1.08 = 864,000 B/Hr

864,000 B/Hr x 1 TON/12000 B/H = 72 TONS.

ELECTRICAL

72 TONS x 0.7 KW/TON = 102.9 KW

SAVINGS AT PEAK DESIGN

ENERGY

NET ELECTRICAL DECREASE = 145.3 - 102.9 = 42.4 KW

NET GAS INCREASE = 647,500 - 1,562,500 = -915,000 B/hr

ELC savings on per hour basis (use 3.5¢/kwh)

42.4 KW * 1 hr * 0.035 $/kwh = $1.48/hr

Nat gas costs per hr = $0.915 \frac{\text{MBtu}}{\text{hr}} * \frac{\$2.70}{\text{MBTU}}$ = $2.47/hr

COST SAVINGS

$1.48/hr - $2.47/hr = -$0.99/hr

There are no savings.

Engineered Air Systems
1455 Tullie Cir. Suite 102 Atlanta, Ga. 30329
FAX (404) 325 9222 OFFICE (404) 325 5600

February 29, 1996

Reynolds, Smith & Hills
4651 Salsbury Rd.
Jacksonville, FL 32256

By fax: 904 279-2489

Attn: Paul Hutchins

Re: Ft. Gordon Hospital

Dear Sirs,

Please find below the evaluation of operating cost and capital cost that we discussed a couple of weeks ago. I apologize for the delay.

Please call me if you have any questions or if I can provide any additional information.

Very truly yours,

Michael P Hayes

MI4 -3

Load Analysis

I have made the following assumptions based on the design information and the discussion I had with the operating engineer and Curt Ogelspe.

To meet the load 65 F drybulb, 50 F dewpoint, 55 grains air needs to be supplied to the space.

Outside design 94 F dry bulb, 67 F dewpoint, 100 grains

Boiler efficiency is 80 %
Cooling system requires 0.90 KW per ton
The above includes chillers, cooling towers, pumping, etc.

Conventional system:

Must cool to 50 F and then apply reheat to 65 F

Cooling:

(94 - 50) F x 28,000 CFM x 1.08 = 1,330,560 B/Hr or 111 tons
(100 - 55) grains x 28,000 CFM x 0.68 = 856,800 B/Hr or 71 tons

Total Cooling 182 tons

Total Kw = 182 x .9 = 164 KW

Reheat:

(65-50) F x 28,000 CFM x (1.08) = 453,000 B/Hr
At 80% efficient boiler 453,000/.80 = 567,000 B/Hr Gas Input or 5.67 therms

Desiccant System:

With 94 F db, 100 grains desiccant requires 1,250,000 B/Hr to produce 50 F dewpoint, 55 grain air at 90 F drybulb without exhaust recovery and 80 F drybulb with exhaust recovery. With a 80% efficient boiler this would require 1,562,000 gas input or 15.62 therms

Cooling:

(90 - 65) x 28,000 CFM x 1.08 = 756,000 B/Hr or 63 tons use this for eval.

(80 - 65) x 28,000 CFM x 1.08 = 453,600 B/Hr or 38 tons

Total KW = 63 x .9 = 57 KW

Operating Costs

Net electrical decrease: 164 - 57 = 107 KW
Net gas increase: 15.62 - 5.67 = 9.95 therms

It is my understanding that Ft. Gordon is on RTP for electric and Interruptible for gas

The RTP rate is a fluctuating rate based on demand. In the cooling season this rate is as low as $ 0.019 per KW at night and $ 0.52 per KW in the afternoon. A review of this rate with some users indicates that the summer average is between $ 0.05 to $ 0.07 in the summer and that the average during the cooling period 8 am to 6 pm is between $ 0.10 to $ 0.13. For this analysis I will use $ 0.11 per KW

The interruptible gas rate is $ 0.25 per therm summer pricing

Based on your operating schedule there are approximately 2000 ton hours

Electric cost savings: 107 KW x 2000 hours x $ 0.11 = $ 23,540
Gas cost increase: 9.95 therms x 2000 x $ 0.25 = $ 4975

Net Savings: $ 18,475

Capital Cost

The cost of this equipment is $ 126,000 (material only)
It would from the above be able to displace 119 tons of conventional cooling system including chillers, cooling towers, pumping systems, reduced row coils

CONSTRUCTION COST ESTIMATE

Project:	ECO# MI4 Natural Gas Desiccant Cooling	RS&H No.:	6941331005
Location:	Fort Gordon, GA	Date:	3/11/96
Basis:	Schematic Design	Estimator:	G.W.FALLON
Building:	EISENWOWER ARMY MEDICAL CENTER	Filename:	EST_MI4.XLS

	QUANTITY		MATERIAL/EQUIP		LABOR		TOTAL	SOURCE	
ITEM DESCRIPTION	No.	Unit	$/Unit	Total	$/Unit	Total	COST	Material	Labor
Desiccant Cooling System	1	ea	$126,000	$126,000	$16,800	$ 16,800.00	$142,800	Vendor	MMp429
Subtotal Bare Costs				$126,000.00		$ 16,800.00	$ 142,800.00		
Retrofit Cost Factors			0%	$ -	0%	$ -	$ -	MMp6	MMp6
				-		-	-		
Subtotal				$126,000.00		$ 16,800.00	$ 142,800.00		
City Cost Index (Aug. GA)			0%	$ -	-46%	$ (7,728.00)	$ (7,728.00)	MMp533	MMp533
				-		-	-		
Subtotal				$126,000.00		$ 9,072.00	$ 135,072.00		
OH & Profit Markups			10%	$ 12,600.00	53%	$ 4,808.00	$ 17,408.00	MMp7	MMp475
				-		-	-		
Subtotal				$138,600.00		$ 13,880.00	$ 152,480.00		
Sales Taxes			6.0%	$ 8,316.00		NA	$ 8,316.00	MMp476	
				-		-	-		
Subtotal				$146,916.00		$ 13,880.00	$ 160,796.00		
Contingency			10%	$ 14,692.00	10%	$ 1,388.00	$ 16,080.00	MEp6	MEp6
				-		-	-		
Subtotal construction Cost				$161,608.00		$ 15,268.00	$ 176,876.00		
Design Fee				NA	6.0%	$ 9,648.00	$ 9,648.00		
SIOH				NA	6.0%	$ 9,648.00	$ 9,648.00		
				-		-	-		
Total Project Cost				$161,608.00		$ 34,564.00	$ 196,172.00		

LEGEND:

MMp###	1996 Means Mechanical Cost Data, page ###.
MEp###	1996 Means Electrical Cost Data, page ###.

MI4-6

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: MI4
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO-MI4 NATURAL GAS DESICCANT COOLING
FISCAL YEAR 1996 DISCRETE PORTION NAME: OPTION A
ANALYSIS DATE: 03-11-96 ECONOMIC LIFE 20 YEARS PREPARED BY: W. TODD

1. INVESTMENT

A. CONSTRUCTION COST	$ 176900.		
B. SIOH	$ 10614.		
C. DESIGN COST	$ 10614.		
D. TOTAL COST (1A+1B+1C)	$ 198128.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 198128.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1991

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 7.62	833.	$ 6347.	13.68	$ 86833.
B. DIST	$ .00	0.	$ 0.	14.64	$ 0.
C. RESID	$ .00	0.	$ 0.	16.00	$ 0.
D. NAT G	$ 2.70	-2804.	$ -7571.	17.25	$ -130596.
E. COAL	$ .00	0.	$ 0.	15.38	$ 0.
M. DEMAND SAVINGS			$ 0.	15.38	$ 0.
N. TOTAL		-1971.	$ -1223.		$ -43763.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 12.90
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ -1223.

5. SIMPLE PAYBACK PERIOD (1G/4) ****** YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ -43763.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= -.22
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

E. OPERATION AND MAINTENANCE BACKUP DATA

Southern Energy Systems Co.
Piping and Pressure Vessel Service
Boiler Maintenance and Repair

3350 Commerce Drive • North Leg Industrial Park • (706) 733-6562
P.O. Box 14219 • Augusta, Georgia 30919 • 1-800-768-0477

To: Johnson Control
P.O. Box 7506
Augusta, GA. 30905-5320

Attention: Mr. Bob Calhoun

cc: Jack Hayes

Re: Purchase request 2200-6-049 (Boiler Feedwater (FW) System Malfunction).

Gentlemen:

Southern Energy Systems (SES) investigated the problem with results as follows:

1. Definition of the problem:

Intermittent slugs of boiler water entrained in steam were observed. This manifested itself as severe water hammer in the steam lines and as water in the atomizing steam. This latter condition was so severe that it caused flameout when burning oil.

2. Findings

A). The carryover of boiler water is caused by several contributing factors:

1. There is a very large fluctuating steam demand, probably from a single device or group of devices. It cycles from 0 to 8,000 lbs/hr steam ($8X10^6$BTU/Hr) at a steady rate of 6 1/2 times per hour. This large and fast rate of fluctuation was the root cause of the problem. After investigation, we were able to eliminate the barracks system, but unable to identify the cycling device in the hospital.

2. The boilermaster control load follower was set to maximum sensitivity.

3. Each boiler is provided with a large and efficient economizer. The economizer adds a ΔT of 25°F to the FW at high fire and 0°F at low fire.

4. The boiler feedwater level controls are single- element. They are in good working order, but slow in response.

5. There are no steam separation devices in boiler drums. The feedwater distributor lines are primitive and ineffective. There is no allowance for water level adjustment in these boilers. $1000/blr for [illegible] [illegible]

B). In the start-up period between 4 AM and 9 AM in April and May 1996. The single boiler on line cycled between 13% and 89% of full power as measured by the fuel-air throttle. This cycle occurred about every eight to 10 minutes. The steam flow and pressure cycled accordingly, lagging by about 1 minute. The feedwater temperature and the feedwater control valve opening lagged 1 1/2 minute behind the flow cycle. The net result being an ever-increasing fluctuation in water level which peaked out about 1 1/2 hours after each maximum period began. This boiler design is very sensitive to water level variations.

C). Additionally, the steam traps on the atomizing steam lines were improperly installed (and probably not functioning).

3. Recommendations:

A). Reduce the sensitivity of the boiler master controller. This was done.

B). Install new steam traps on the atomizing steam liner. This was done.

C). Change the piping to allow condensate to properly drain to the traps in the atomizing steam line. This was done on #2 boiler by SES personnel to demonstrate. It will necessary to disconnect 3 unions when required to enter the to lower drum. Plant personnel should re-pipe the other two boilers in the same fashion.

D. Install a proper feedwater distribution line in each boiler. $1000/blr

4. Results:

A. Oil was burned for 24 hours several times during May by plant personnel- no adverse results.

B. Oils was burned 4-11 AM 31 May 96 with SES personnel observing no hammer, no water in atomizing steam. Fluctuation in fuel, air, throttle was down to 38-52%. At this rate water the level controller is fully adequate.

C. Condition will be more severe in mid-winter. Items 3 C) & D) above should be completed before then.

D. No other action is indicated.

We appreciate the opportunity to be of service. If we can be of assistance on this or any related matter please contact us at anytime at the above address.

Sincerely:

Mike O'Grady

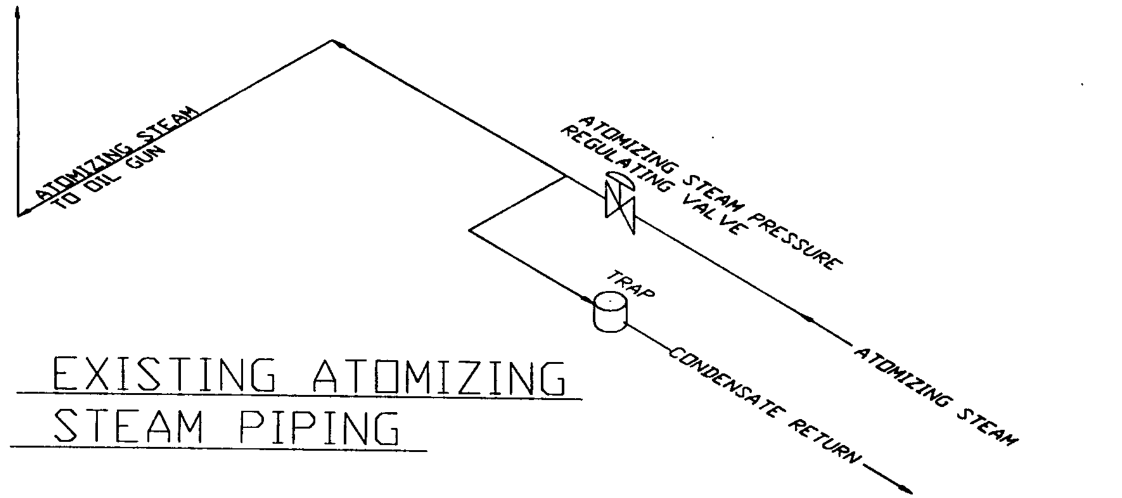
Mike O'Grady

sg

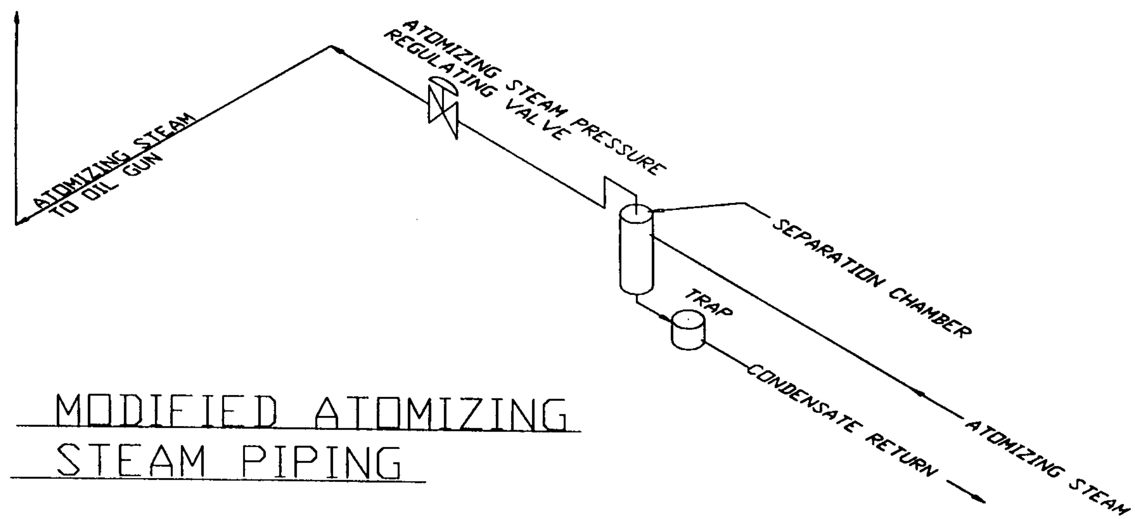
sg

AS-3

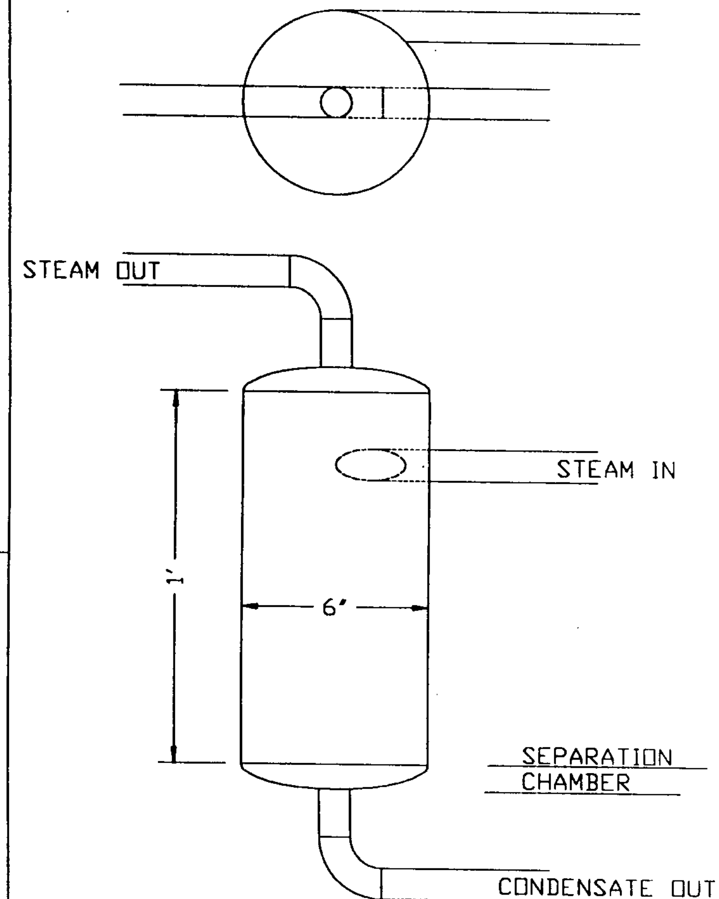
AS-4



EXISTING ATOMIZING
STEAM PIPING



MODIFIED ATOMIZING
STEAM PIPING



SCALE	NONE	DATE	PROJECT EISENHOWER ARMY HOSPITAL FT. GORDON, GA
DRAWN	G.W.F.	9-6-96	
CHECKED	---	---	
APPROVED			

TITLE
ATOMIZING STEAM PIPING MODIFICATION

FE
Fallon Engineering
4081 Tyndel Creek Place
Jacksonville, FL 32223
(904) 260-9658

DRAWING NUMBER SK-1
SIZE C
PROJECT NO. -----

REVISION 3 2 1 x

FINAL

RS&H®

SUBJECT Ft Gordon Hospital
ECO BP4
DESIGNER GWF.
CHECKER
AEP NO
SHEET 1 OF
DATE 2-29-96
DATE

O&M ENERGY SAVINGS — REDUCE BOILER MAKE UP WATER

AUTOCLAVE STEAM DEMAND (AVG)

TOTAL DESIGN FLOW FOR ALL 12 AUTOCLAVES = 743 #/HR
STANDBY LOSSES ARE ABOUT 65 #/Hr
AUTOCLAVES SUPPORT SURGICAL ACTIVITIES SCHEDULED 8 HRS/DAY 5 DAY/WEEK.
ASSUME AUTOCLAVES OPERATE 4 HRS/DAY.
TOTAL ANNUAL STEAM USE IS 2292 MBTU/yr

Average daily use:
From following spreadsheet

$$Avg = (825\ g/d \times 5 \times 52 + 240\ g/d \times 2 \times 52) \div 365$$
$$= 656\ gal/da$$

BLOWDOWN

BOILERS BLOWN DOWN ONCE PER DAY PER OPERATING BOILER
ASSUME 2"ø BLOWDOWN, 90 psig DP, 100 FT PIPE,
30 SECOND BLOW (10 to open, 10 to close, 10 to Blow),
FULL FLOW FOR 10 SEC. 1/2 FLOW FOR 20 sec.

FROM ASHRAE CHART FLOW = 250 gpm

DAILY MAKE-UP DUE TO BLOW DOWN

$$250\ gpm \times \frac{10}{60} + 250/2 \times \frac{20}{60} \times 2\ \text{BOILERS} = 167\ gpd$$

ENERGY LOSS FROM BLOW DOWN

$$E_{L-BD} = \frac{167\ gpd \times 365\ D/yr \times 8.34\ LBS/gal \times (331.37 - 65)}{10^6\ B/MB} = 135\ MBTU/yr$$

ENERGY LOSS FROM STEAM LEAKS

FIELD OBSERVATIONS INDICATED SYSTEM WAS "TIGHT"
ASSUME 10 LEAKS @ 1 CFM & 0 psig

$$E_{L-ST} = 10 \times 1\ CFM \times 1\ LB/26.8\ CF \times 8760\ Hr/yr \times (1188 - (65-32)) \times 10^{-6}$$
$$= 3.77\ MBTU/yr$$

BM-1

Eisenhower Army Medical Center
Fort Gordon Augusta, GA
Boiler Performance Analysis
Filename: BOILF1.WK4

Day of Week	Time	Outside Temp. (F)	Steam Flow (klbs/da)	Steam Flow (kBtu/hr)	Gas Use (kcf/hr)	Boiler Eff (%)	Make-up Water (gal/d)	Make-up Water (lbs/d)	Make-up Water (%)
T	10/25/94	79	162	6.6	106	146.6	2000	16,600	10.2
W	10/26/94	69	185	7.6	137	129.5	2500	20,750	11.2
T	10/27/94	69	210	8.6	148	136.1	800	6,640	3.2
F	10/28/94	57	215	8.8	177	116.5	1100	9,130	4.2
S	10/29/94	55	190	7.8	159	114.6	1300	10,790	5.7
S	10/30/94	64	175	7.2	151	111.2	1200	9,960	5.7
M	10/31/94	72	143	5.9	133	103.1	1100	9,130	6.4
W	1/18/95	54	217	8.9	291	71.5	2440	20,252	9.3
T	1/19/95	55	226	9.3	292	74.2	2306	19,140	8.5
F	1/20/95	43	233	9.6	308	72.6	1800	14,940	6.4
S	1/21/95	41	224	9.2	279	77.0	1400	11,620	5.2
S	1/22/95	43	240	9.9	300	76.7	1140	9,462	3.9
M	1/23/95	40	232	9.5	294	75.7	1000	8,300	3.6
T	1/24/95	37	269	11.0	344	75.0	1100	9,130	3.4
M	04/10/95	75	142	5.8	202	67.4	0	0	0.0
T	04/11/95	70	143	5.9	203	67.6	0	0	0.0
W	04/12/95	72	133	5.5	216	59.1	2500	20,750	15.6
T	04/13/95	72	147	6.0	291	48.5	0	0	0.0
F	04/14/95	68	166	6.8	296	53.8	0	0	0.0
S	04/15/95	68	165	6.8	220	71.9	0	0	0.0
S	04/16/95	71	157	6.4	212	71.0	0	0	0.0
S	07/01/95	75	91	3.7	124	70.4	2200	18,260	20.1
S	07/02/95	78	83	3.4	114	69.8	1500	12,450	15.0
M	07/03/95	79	87	3.6	122	68.4	1700	14,110	16.2
T	07/04/95	79	85	3.5	117	69.7	1900	15,770	18.6
W	07/05/95	84	84	3.4	126	64.0	2600	21,580	25.7
T	07/06/95	85	84	3.4	118	68.3	2800	23,240	27.7
F	07/07/95	82	85	3.5	119	68.5	2300	19,090	22.5
	Avg.s		157	6.4	218	68.9	1758	14,595	9.3
	Avg./hr		6.5					608	

RS&H®

SUBJECT

AEP NO

SHEET OF

DESIGNER

DATE

CHECKER

DATE

DAILY MAKEUP DUE TO STEAM LEAKS

$$MU = 10 \times 1\,CFM \times \frac{1\,LB}{26.8\,CF} \times \frac{1\,gal}{8.34\,LB} \times 60\,M/H \times 24\,H/D$$

$$= 64.4\ gal/DAY.$$

DAILY MAKEUP DUE TO UNKNOWN LOSSES

DATA INDICATES AVERAGE DAILY MAKE-UP IS 1758 gallons

UNKNOWN LOSSES = TOTAL − AUTOCLAVES − BLOWDOWN − STEAM LEAKS

$= 1758 - 656 - 167 - 64.4$

$= 870.6$ gpD

ENERGY LOSS IN UNKNOWN LOSSES

ASSUME: 33% IS condensate

33% IS BOILER WATER

33% IS STEAM

LOSS DUE TO CONDENSATE

$$\frac{870.6\,gpD \times 0.33 \times 365\,D/Y \times 8.34\,\#/gal \times (150-65)}{10^6\,BTU/MBTU \times 0.8} = 93\ \frac{MBTU}{Yr}$$

LOSS DUE TO BOILER WATER

$$\frac{1112.6 \times .33 \times 365\,d/y \times 8.34\,\#/gal \times (331-65)}{10^6\,BTU/MBTU \times 0.8} = 371\ MBTU/Yr$$

LOSS DUE TO STEAM

$$\frac{1112.6 \times 0.33 \times 365\,d/y \times 8.34\,\#/gal\,(1188-(65-32))}{10^6\,BTU/MBTU \times 0.8} = 1614\ MBTU/Yr$$

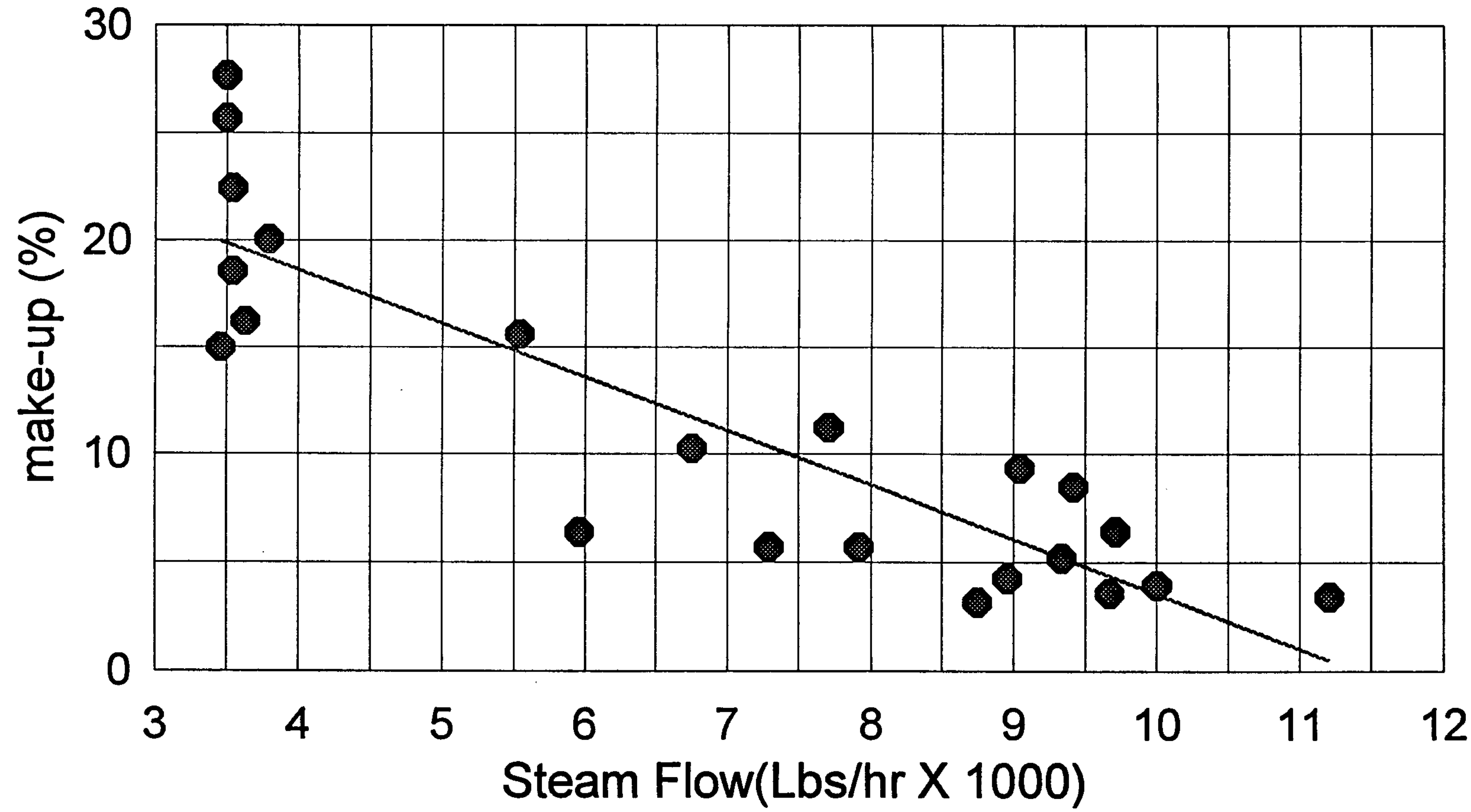
TOTAL UNKNOWN LOSSES

$E_{L-UK} = 93 + 371 + 1614 = 2078$ MBTU/yr.

Value of unknown losses = 2078 × 2.7 = $5610 /yr.

EISENHOWER AMC

Make-up



BM-4

EISENHOWER ARMY MEDICAL CENTER
STERILIZER STEAM USE
FILENAME: STERL.WK4

Manufacturer/Model	Location	#	Average Steam Use (lbs/hr)	(lbs/cyc)	Standby Use (lbs/hr)	Weekday (lbs/da)	Weekend (lbs/da)
Castle (MDT) 3525	OR	2	96	-	-	768	0
AMSCO V116	OR	1	-	18	7	428	168
AMSCO 3000 (1)	OR	1	130	-	13	780	312
AMSCO 3012	CMS	2	56	-	-	448	0
AMSCO 3000/3 Vac.,Med.	CMS	2	185	-	19	2220	888
AMSCO Reliance (Cart Washer) (2	CMS	1	180	-	-	720	0
Castle (MDT) 3522	Dental	1	96	-	12	624	288
AMSCO V116	L & D (3)	1	-	18	7	428	168
AMSCO 444	CMS	1	-	18	7	428	168
Totals		12	743	54	65	6844	1992
Totals (gal/da)						825	240
Annual Totals (MBtu/yr)						2053	239
Grand Annual Total (MBtu/yr)						2292	

Utilization Factor = 0.50
(1) 90 to 180 lbs/hr
(2) 98 to 185 lbs/hr
(3) Labor and Delivery

RS&H

SUBJECT ____
DESIGNER ____
CHECKER ____
AEP NO ____
SHEET ____ OF ____
DATE ____
DATE ____

Sterilizer Steam Use

#	Manufacturer	Loc	Avg (lbs/hr)	Standby Use (lb/hr)
2	Castle (MDT) 3525	OR	96	-
1	AMSCO V116	OR	18 lb/cy (1)	7
1	AMSCO 3000	OR		
2	AMSCO 3012	CMS	56	-
2	AMSCO 3000/3 (Vac.Wd)	CMS	185	10
1	AMSCO Reliance (Cart Washer)	CMS	90-180/cyc (1)	-
1	CASTLE 3522	Dental	96	12
1	AMSCO V116	LED	18 lb/cyc (1)	7
1	AMSCO 444	CMS	18 lb/cyc (1)	-

(1) 15 min cycle

ELECTRICAL SG'S NOT ACCEPTABLE

OR	Steam Avg (lb/hr)	STANDBY	Pre Reg psi
2 castle (MDT) 3525 series (flash)	96 lb/hr	-	5
1 AMSCO V116	18 lb/cy	7	50-
1 " 3000 (small/medium)	98/185	10%	50-

CMS.			
16x16x26 2 AMSCO 3012 no jacket (WASHER/STERILIZER)	56	-	50-
24x36x60" 2 AMSCO 3000/3 (2dr) (vac) (Med.)	185	10%	50-8
1. AMSCO RELIANCE (CART WASHER)	47-126/cycle	-	50-6
	6-12 lbs/min	4cy/hr	15min/cy
DENTAL			
1 CASTLE 3522 (flash)	96	12	50

LED - PART TIME.

1 AMSCO V116	18 lb/cy	7	

CMS

1 INST. WASHER AMSCO 444 has return	18 lb/cycle 15min/cycle	-	30-8

AMSCO - 800 333 8848
8828
MDT - 800 950 9912

MOSTLY USED 40 HR/wk - 5-5 FOR STERILIZATION.
ESTIMATE 90% availability

Sgt. Rail / Sckerman - Med. Maint. (706) 787-8242

RS&H®

Telephone Call Confirmation

Project Number ______________________

(800) 950 - 9912

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 6/24/96

Conversed with Jimmy Adams Of MDT

Regarding Steam Use

Distribution:

BM -8

RS&H®

Telephone Call Confirmation

Project Number ______________

(800) 333-8848

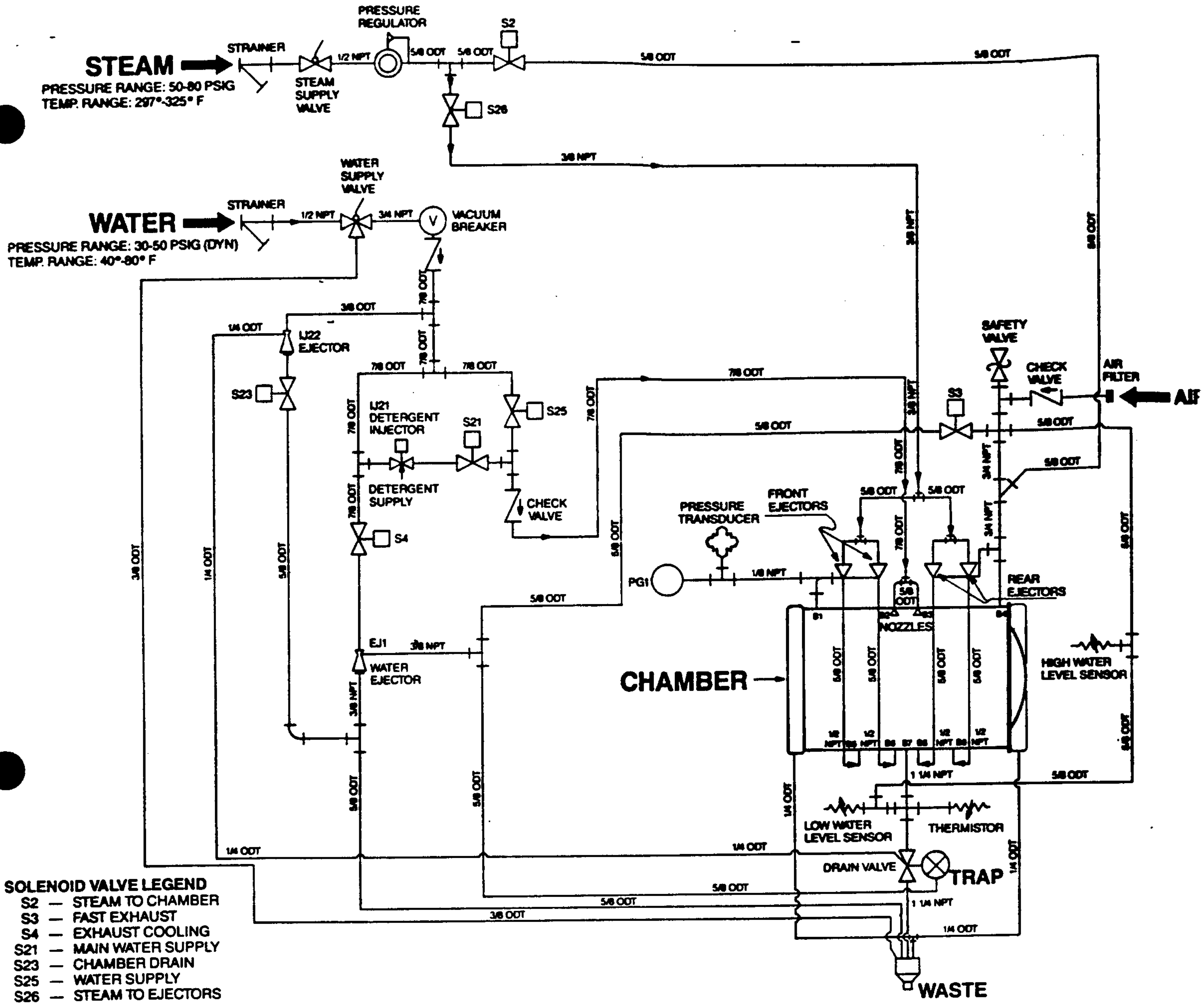
Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 6/24/96

Conversed with Greg Of Amsco

Regarding Avg steam use and standby use

Distribution:

BM-9



Pipin

[redacted]

BM-10

OPTIONAL PREVENTIVE MAINTENANCE AGREEMENT

A coast-to-coast network of skilled and competent specialists can provide periodic PMA inspection and adjustment to ass cost peak performance.

ENGINEERING DATA

SIZE/TYPE In. (mm)	HEATING	MAXIMUM OPERATING WEIGHT[1] lbs (kg)		HEAT LOSS BTU/hr at 70°F (21°C)						
				Single Door			Double Door			
				Cab't Enc	Recessed		Recessed One Wall		Reces Two W	
		Single Door	Double Door	To Room	Front of Wall	Back of Wall	Front of Wall	Back of Wall	At Each End	
16x16x26 (406x406x660) Gravity and Vac	Steam	1410 (637)	1410 (637)	4300	1600	2700	1600	3500	N/A	
	Electric	1410 (637)	N/A	6050	2300	3750	2300	4550	N/A	
20x20x38 (508x508x965) Gravity and Vac	Steam	2128 (966)	2128 (966)	7000	2500	4500	2500	5300	2500	2
	Electric			8750	3300	5450	3300	6250	3300	2

[1]Based on seismic calculations

SIZE/TYPE In. (mm)	UTILITIES CONSUMPTION						ELECTRICAL REQUIREMENTS (Amps)				
	Water[1]				Steam[2]		Electric				
	Cold		Hot[3]								
	Peak gpm (lpm)	Avg gph (lph)	Peak gph (lph)	Avg gph (lph)	Peak lb/hr (kg/hr)	Avg lb/hr (kg/hr)	Ster. Cntrls	Stm./Gen. Ctrls Only (Elec. Units)	Heaters (3 Ph)[4] Amps/Phase		
							120V	120V	208V	240V	48C
16x16x26 Gravity (406x406x660)	5 (19)	98 (371)	12 (45)	4 (15)	83 (38)	35 (16)	1.0	6.0	62.6	72.2	36.
16x16x26 Vac (406x406x660)	15 (57)	164 (611)	12 (45)	10 (38)	83 (38)	70 (32)	1.0	6.0	62.6	72.2	36.
20x20x38 Gravity (508x508x965)	5 (19)	98 (371)	16 (60)	8 (30)	116 (53)	49 (22)	1.0	6.0	62.6	72.2	36.
20x20x38 Vac (508x508x965)	15 (57)	164 (611)	16 (60)	14 (53)	116 (53)	98 (44)	1.0	6.0	62.6	72.2	36.

[1]At 20-50 psig (1.41-3.52 kg/cm²) for gravity units; 30-50 psig (2.11-3.52 kg/cm²) for vac units
[2]At 50-80 psig (3.52-5.62 kg/cm²)
[3]Hot water recommended for electrically powered units
[4]At 208V, nominal capacity of generator is 22.5 kw. At 240V, capacity is 30 kw

SPECIFICATION WORKSHEET

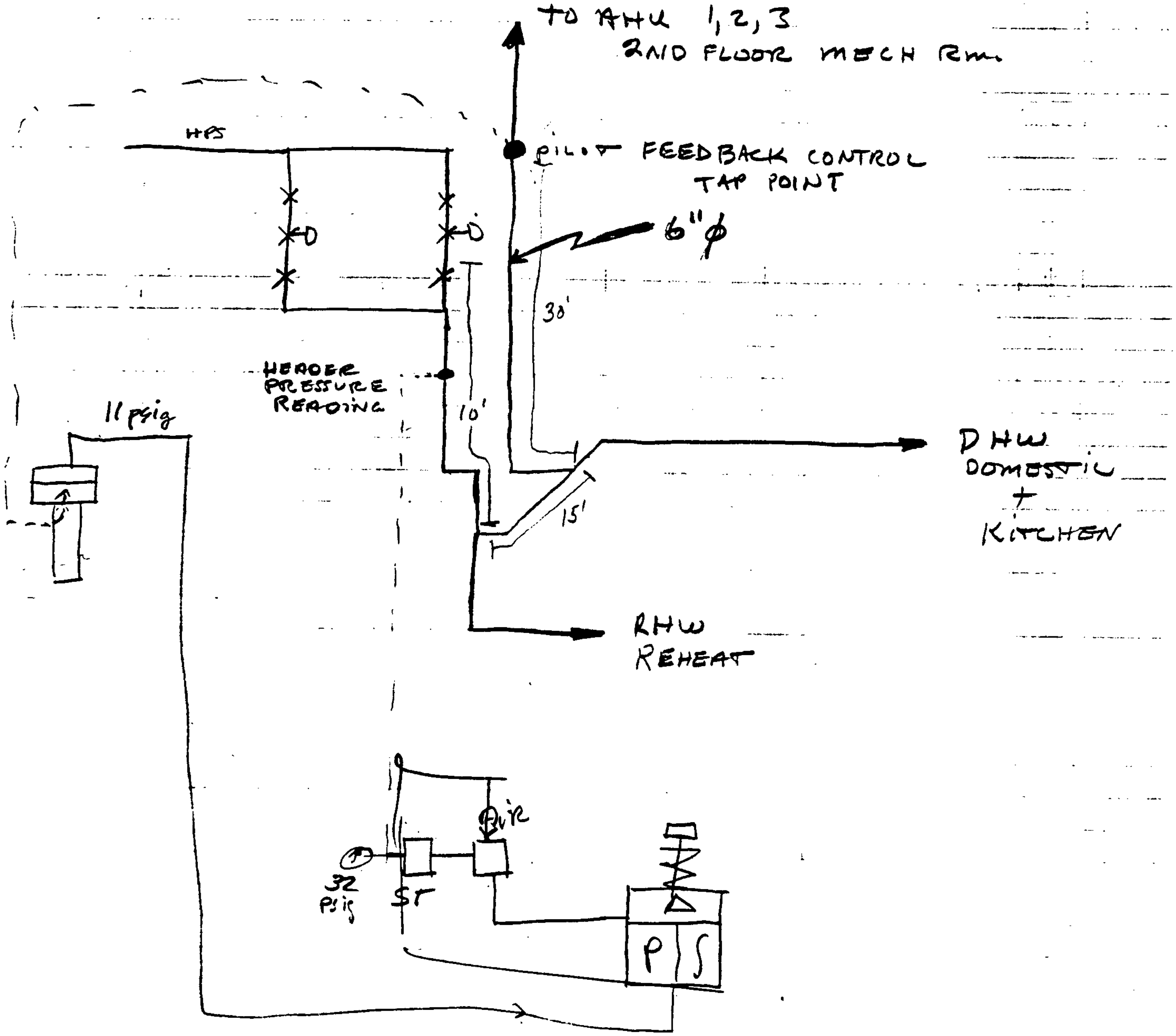
Item_____: Furnish an AMSCO Eagle 3000 Series sterilizer with Stage II control with interactive vacuum fluorescent display and four numerical cycle selection touch pads. Construct nickel clad chamber ☐ 16x16x26" or ☐ 20x20x38". Supply ☐ gravity model or ☐ vacama model. Design control with microcomputer to control system functions, monitor system operations, and visually indicate and print chamber temperature, pressure, time, date and daily cycle number. Equip sterilizer to operate on ☐ steam from an independent source o steam supplied from an integral electric steam generator (except Double Door 16" units). Arrange sterilizer ☐ to be freestanding or ☐ for recessing into a partition wall or ☐ for recessing through two walls (20x20x38" double-door models only). Equip sterilizer with ☐ Utilitie Control Valve Kit option. Equip sterilizer with the following Laboratory/Scientific Options*: ☐ Pure Steam Piping, ☐ Pure Steam Piping with Stainless-Steel Electric Steam Generator, ☐ Door Interlocks, ☐ Door Interlocks with Cross Contamination Seals and ☐ Chamber Penetrations and Accessories.

**See separate Tech Data Sheets for Specifications.*

AMSC

SUBJECT	AEP NO
	SHEET OF
DESIGNER	DATE
CHECKER	DATE

Hospital PRU Station Layout



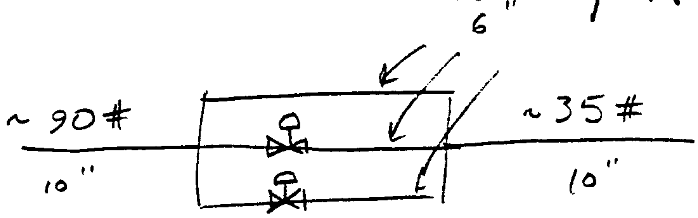
FINAL

RS&H

SUBJECT ______ AEP NO ______
SHEET ______ OF ______
DESIGNER ______ DATE ______
CHECKER ______ DATE ______

Hospital Steam Control Valves

Pressure Regulating Valves Station



New controls installed ~3/96

Hoffman 2200 Valve   Air Pilot - Hoffman AP4A
P# 402490 (9 could be a ∅)
32911GS3206500 Port NP (normal port)

George Israel (904) 355-7867 (John Kay)

Valve max flow is	39,300	#/hr	normal port
	27,000	"	reduced port
	50,000	"	full port

Small sized valves

line	NP	FP
2 1/2"	5100 #/hr	9,100 #/hr
3"	7300 "	13,500 "

PR-2   FINAL

RS&H

SUBJECT ______________________
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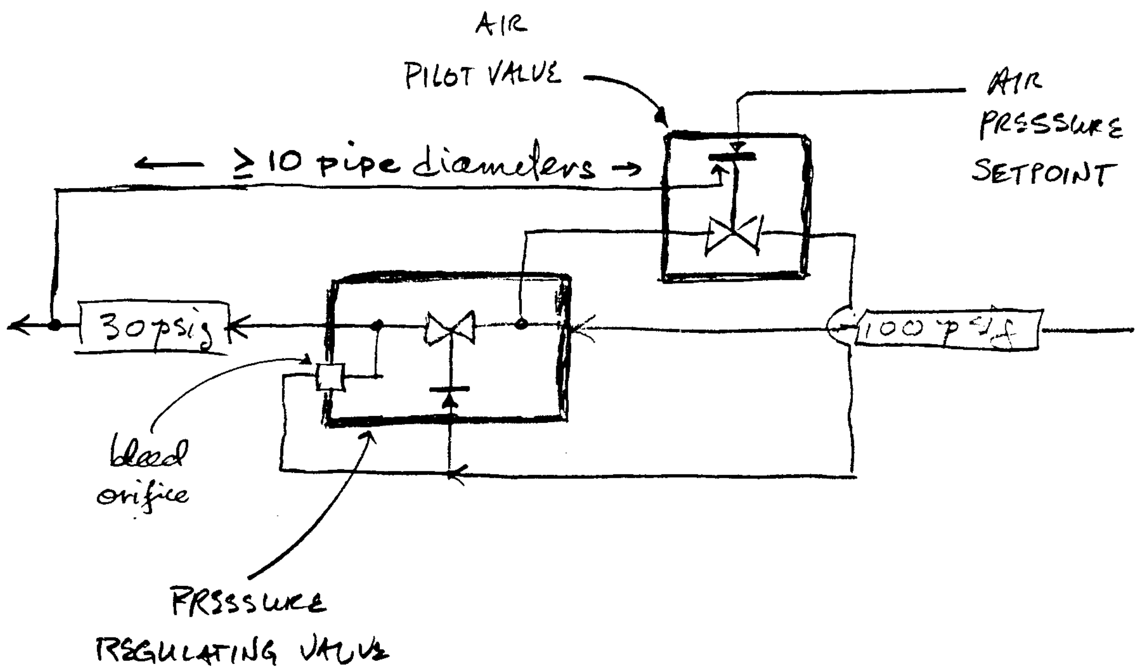
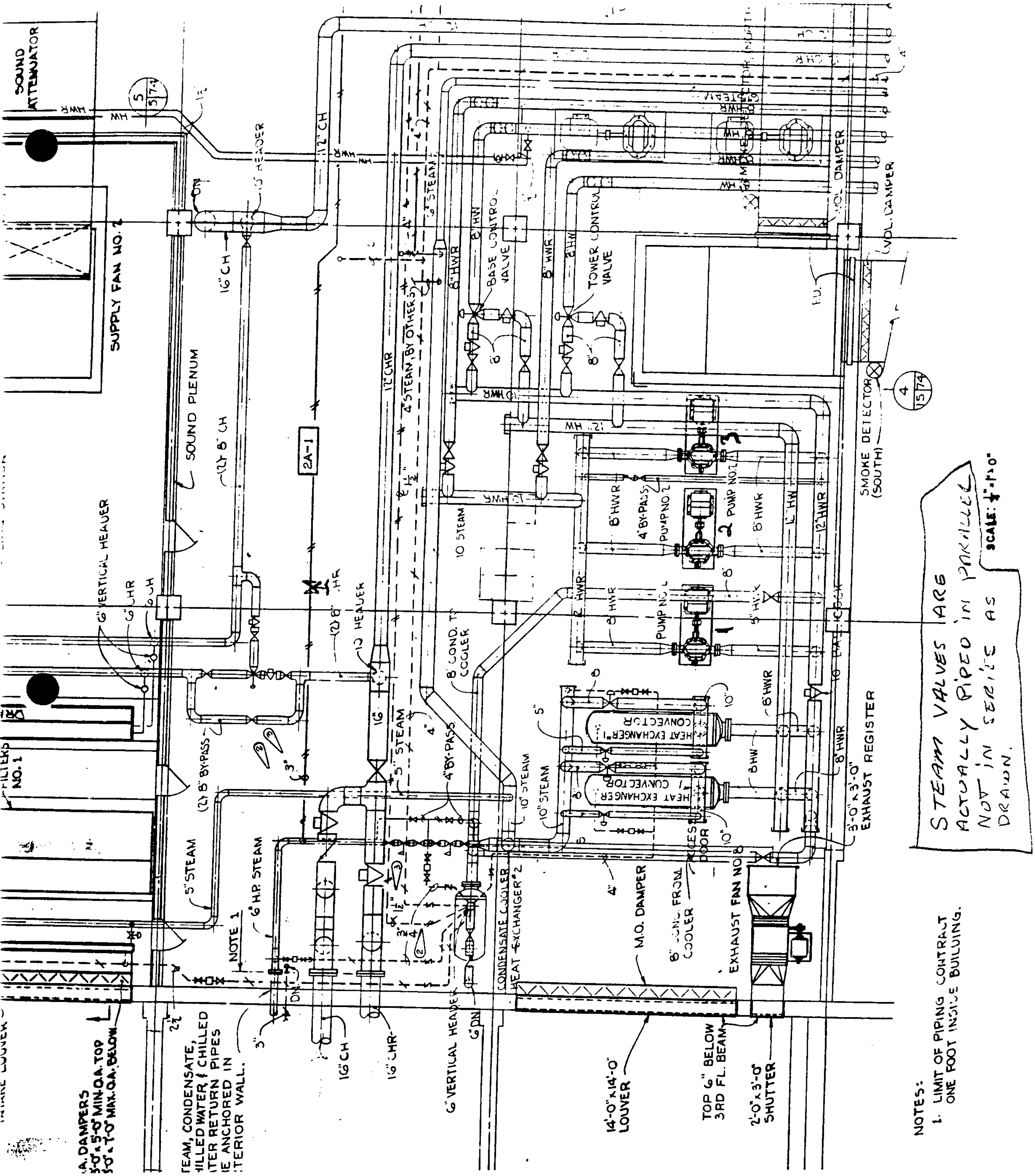
DESIGNER ______________________
CHECKER ______________________

AEP NO ______________________
SHEET __________ OF __________
DATE ______________________
DATE ______________________



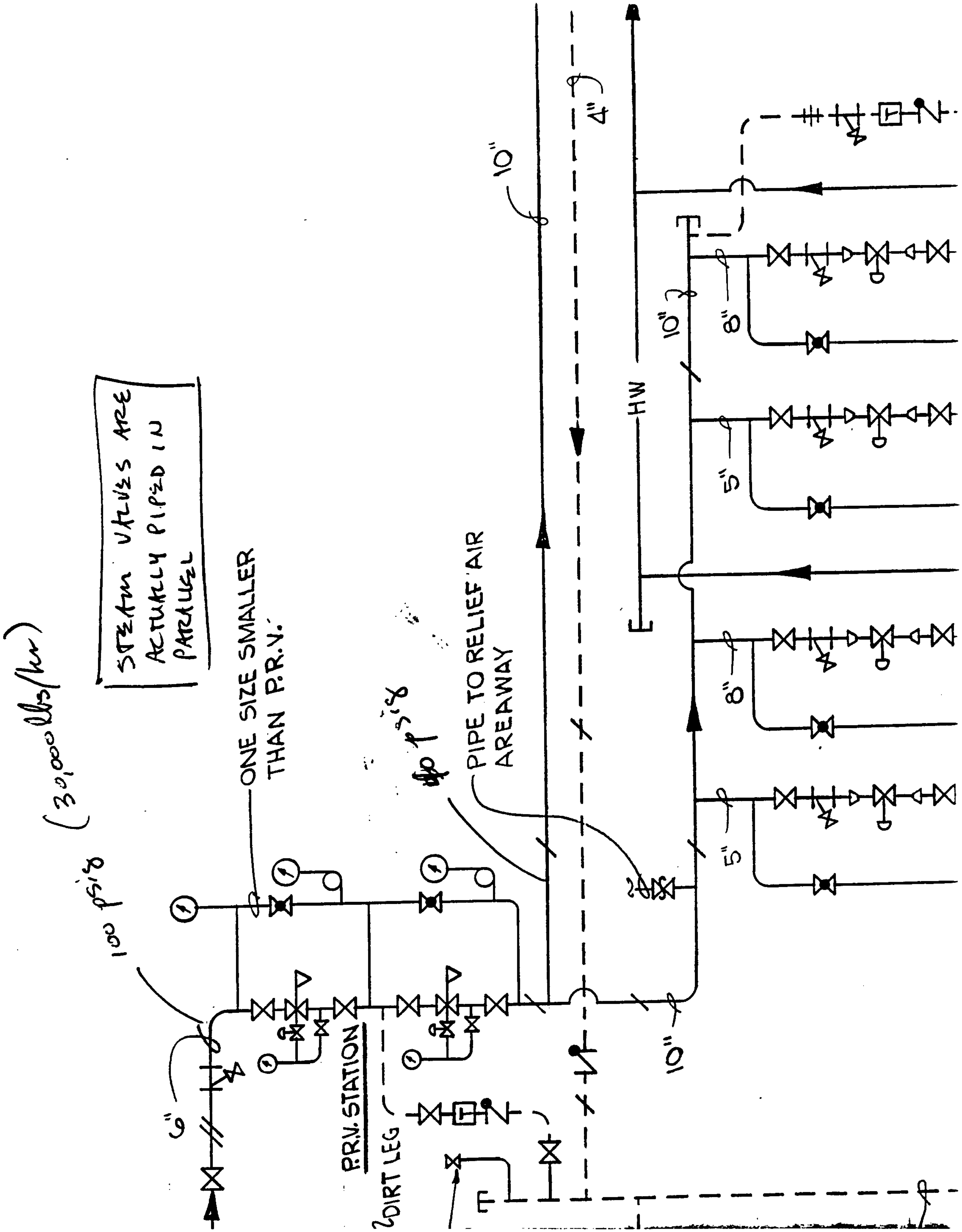
PR-3

FINAL


SOUND ATTENUATOR
SUPPLY FAN NO. 2
SOUND PLENUM
16" CH
(2) 8" CH
2A-1
12" CHR
4" STEAM, BY OTHERS
BASE CONTROL VALVE
TOWER CONTROL VALVE
8" HWR
8" HW
VOL. DAMPER
SMOKE DETECTOR (SOUTH)
PUMP NO. 1
PUMP NO. 2
PUMP NO. 3
4" BY-PASS
12" HW
12" HWR
10" STEAM
8" COND. TO COOLER
10" HEADER
6" VERTICAL HEADER
FILTERS NO. 1
(2) 8" BY-PASS
5" STEAM
6" H.P. STEAM
NOTE 1
HEAT EXCHANGER #1 CONVECTOR
HEAT EXCHANGER #1 CONVECTOR
CONDENSATE COOLER HEAT EXCHANGER #2
ACCESS DOOR
M.O. DAMPER
8" COND. FROM COOLER
EXHAUST FAN NO. 8
3'-0" x 3'-0" EXHAUST REGISTER
16" CH
16" CHR
6" VERTICAL HEADER
6" DN
14'-0" x 14'-0" LOUVER
TOP 6" BELOW 3RD FL. BEAM
2'-0" x 3'-0" SHUTTER
O.A. DAMPERS 3'-0" x 5'-0" MIN. O.A. TOP 3'-0" x 7'-0" MAX. O.A. BELOW
STEAM, CONDENSATE, CHILLED WATER & CHILLED WATER RETURN PIPES ARE ANCHORED IN EXTERIOR WALL.
NOTES:
1. LIMIT OF PIPING CONTRACT ONE FOOT INSIDE BUILDING.
STEAM VALVES ARE ACTUALLY PIPED IN PARALLEL NOT IN SERIES AS DRAWN.
SCALE: 1/4" = 1'-0"

PR-4

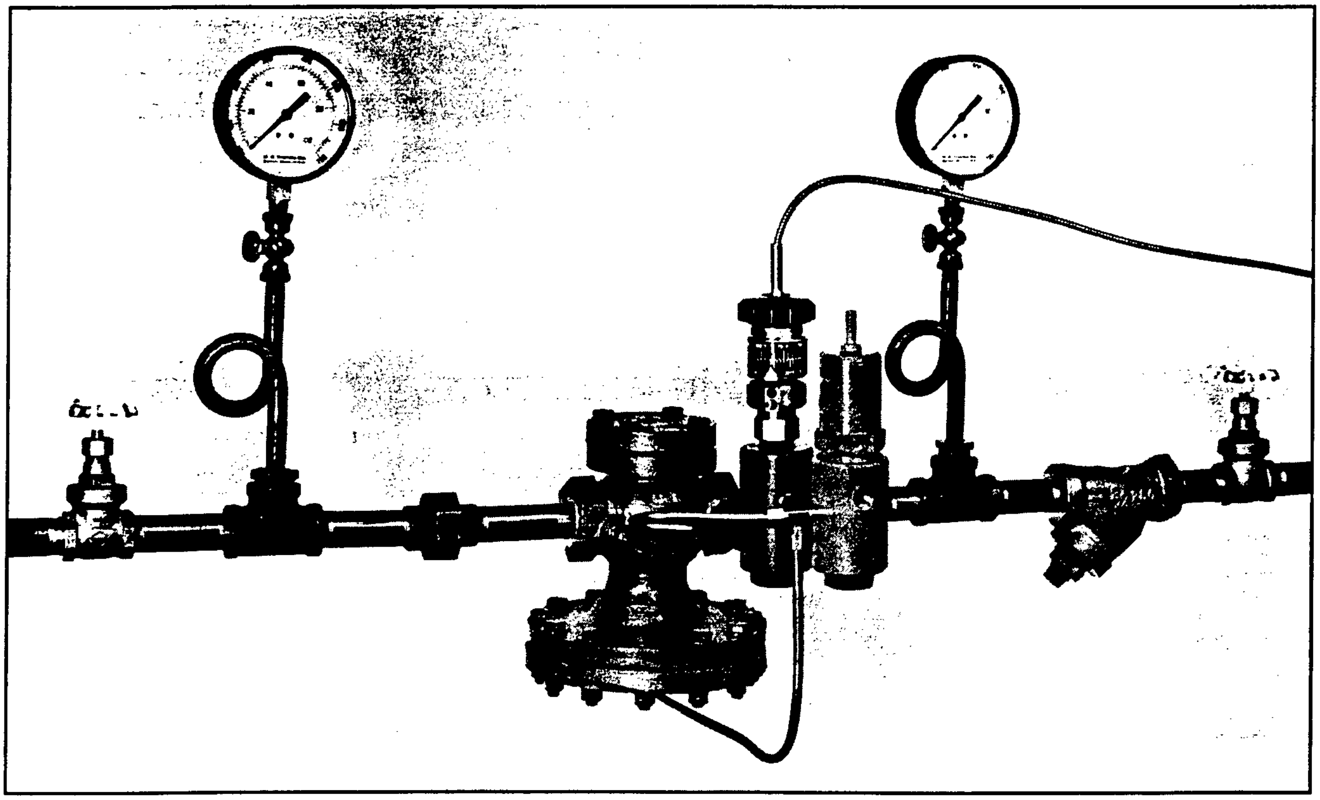
FINAL


STEAM VALVES ARE ACTUALLY PIPED IN PARALLEL
(30,000 lbs/hr)
100 psig
6"
ONE SIZE SMALLER THAN P.R.V.
40 psig
PIPE TO RELIEF AIR AREAWAY
P.R.V. STATION
DIRT LEG
10"
10"
10"
4"
HW
8"
5"
8"
5"

INSTALLATION & OPERATING INSTRUCTIONS
HS-601

Hoffman SPECIALTY

Pilot Operated Pressure and/or Temperature Steam Regulators Series 2000



PLEASE READ INSTRUCTIONS COMPLETELY BEFORE STARTING WORK. ALL WORK MUST BE PERFORMED BY QUALIFIED PERSONNEL IN ACCORDANCE WITH ALL APPLICABLE CODES AND ORDINANCES.

CAUTION:
- **TURN OFF STEAM SUPPLY BEFORE INSTALLING OR SERVICING.**
- **OPEN SUPPLY VALVES SLOWLY TO PREVENT WATER HAMMER OR SUDDEN SHOCK.**
- **WEAR HEAT RESISTANT GLOVES BEFORE ADJUSTING STEAM VALVES.**

IMPORTANT: Handle regulator with extreme caution. Do not lift regulator by any external tubing.

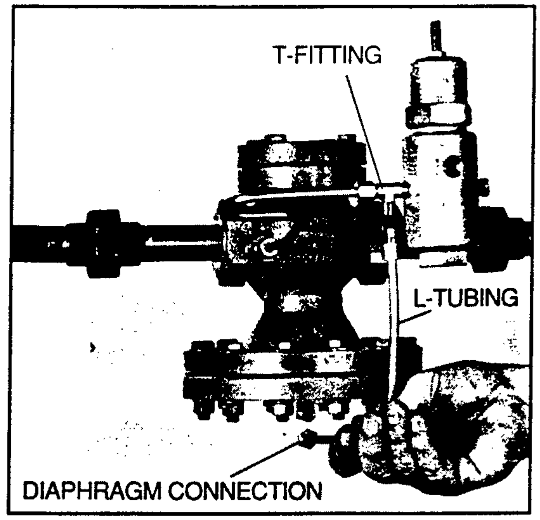
If you are uncertain as to the product's adaptability for your application, please call the factory or authorized representative before installing or using the product.

PR-6

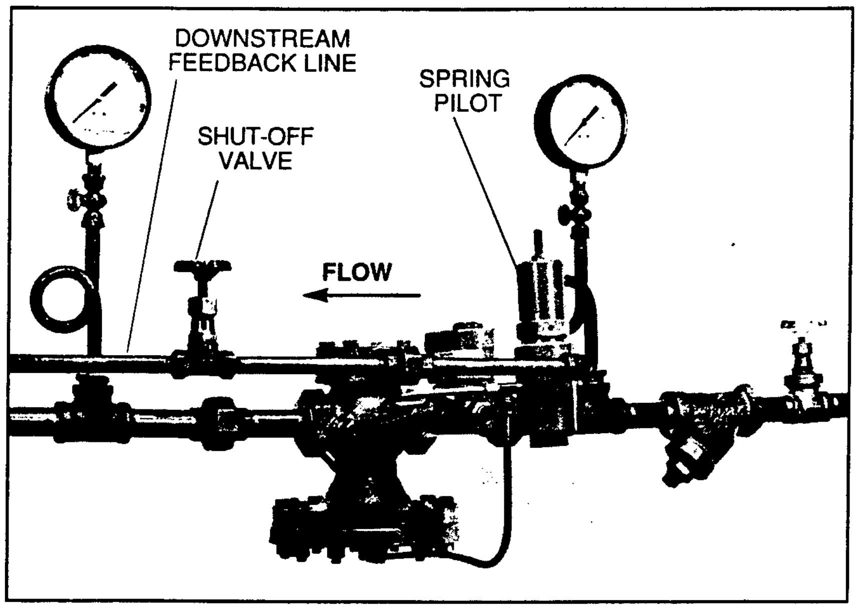
FINAL

Spring / Air Pilots (Continued)

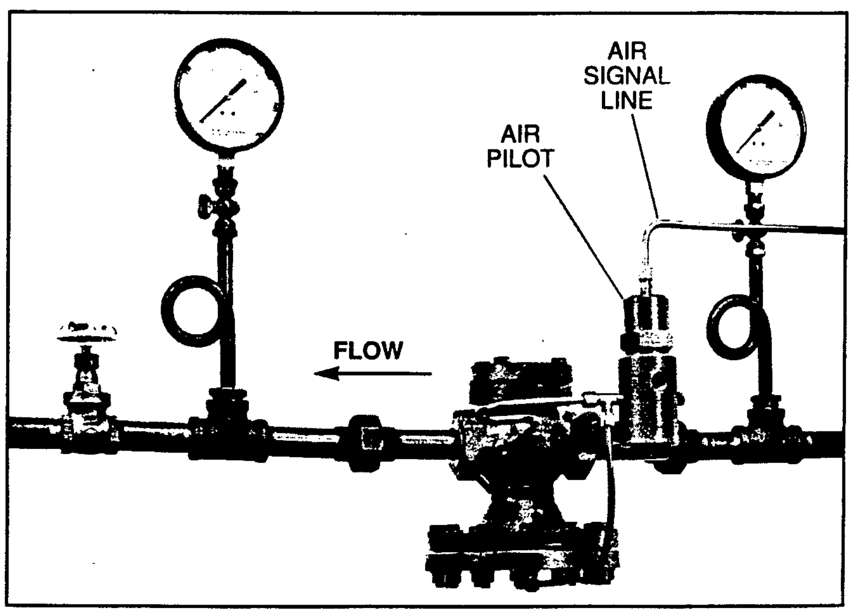
e. Install the L-tubing from the bottom of the T-fitting to the main valve diaphragm connection.



f. Install a downstream feedback line to sense downstream pressure using ¼" black steel pipe or 5/16" tubing. Install a shut off valve in the line. The feedback line should connect to the top or side of the outlet stream line at least 10 pipe diameters downstream of any valve elbows. The feedback line should pitch down from the pilot.



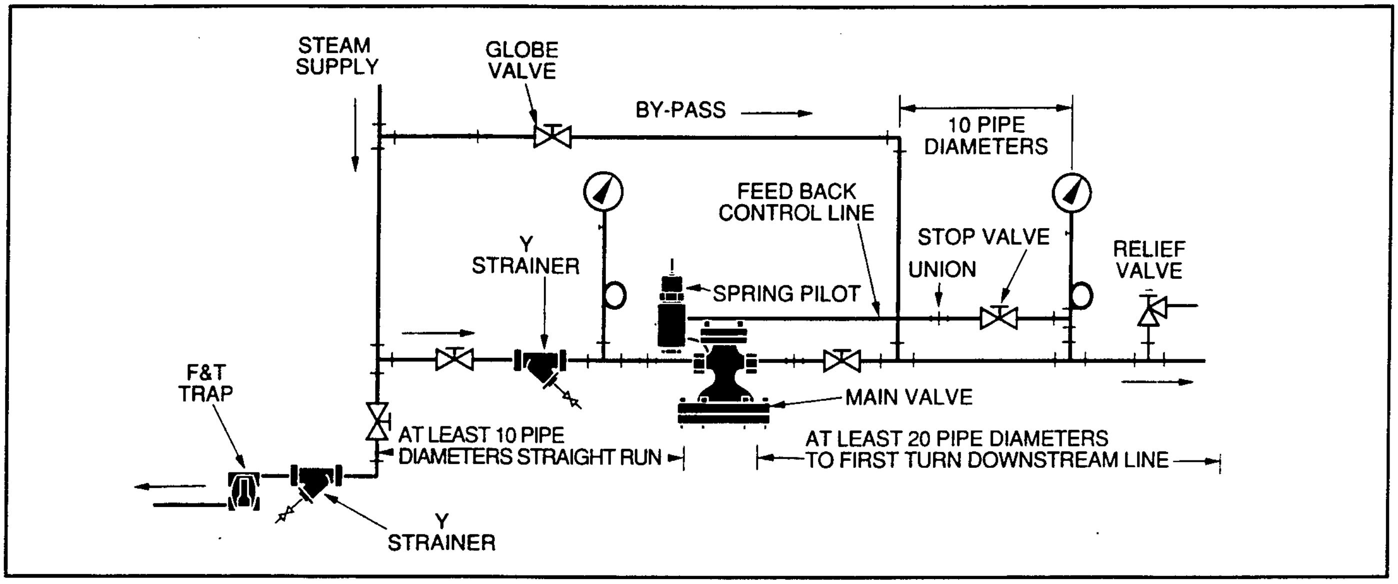
g. For air pilot installations, the air signal connects to the top of the pilot bonnet.



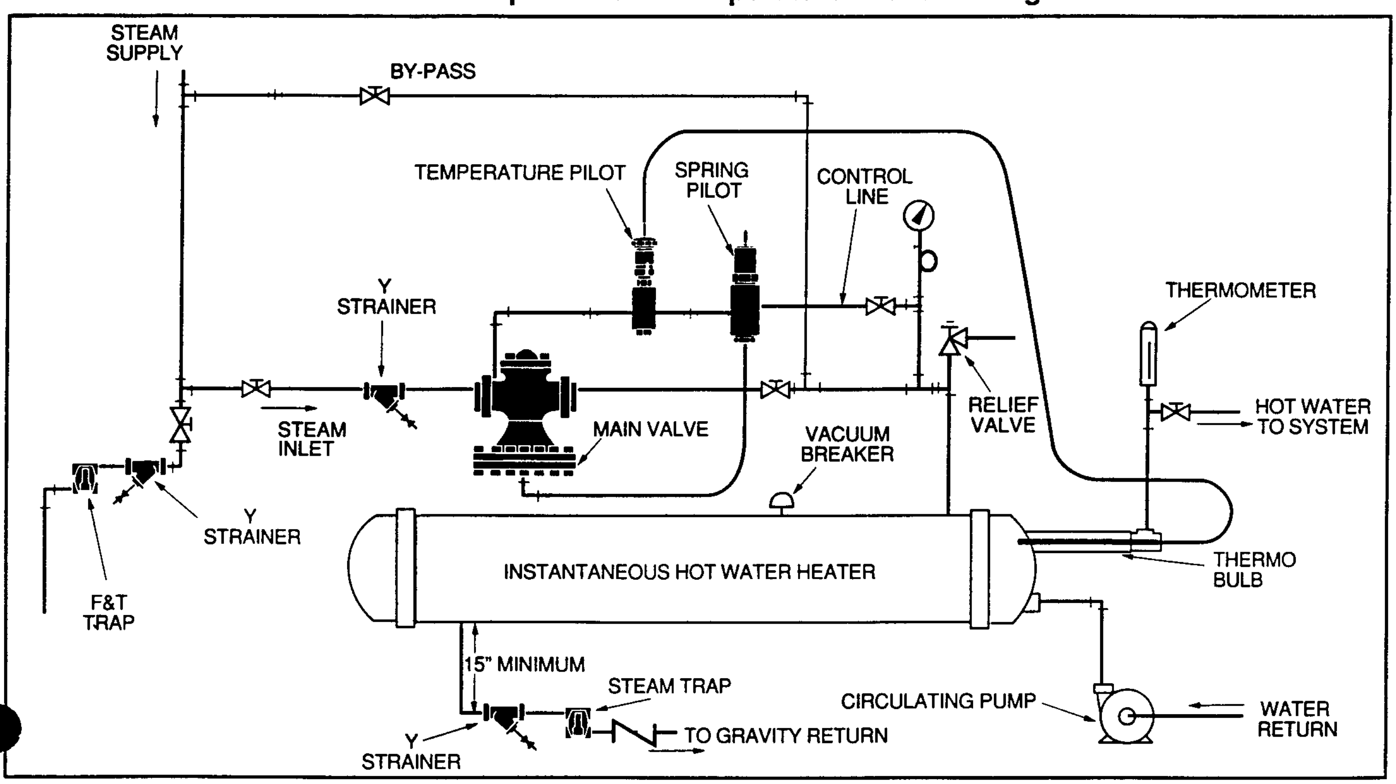
PR-7 FINAL

Typical Installation Piping Diagrams

Series 2000 Pressure Regulator



Series 2000 Temperature or Temperature/Pressure Regulator



PR-8
FINAL

capacity of both valves. Typically one valve is sized to operate during low loads while the second valve remains closed. This means the primary valve is traditionally one third of the required system capacity. The other valve is then two-thirds. When the system demand increases above the capacity of the primary valve the secondary valve will open and supply steam to maintain the desired downstream pressure. The primary-secondary valve arrangement widens the capacity range and reduces the tendency to wire draw the seats.

Do not oversize. Oversized valves will "hunt" and will also wear prematurely. Resist the temptation to size the valve to the pipe size around it. The correct valve will normally be smaller.

System Pressure Drop: Select PRV station for a pressure drop (Δ P) no greater than 150 psig. (We recommend a maximum Δ P of 100 psig per valve. Higher pressure drops shorten plug and seat life.)

Leakage: Dead end flow applications must allow for a minimum leakage of 0.01 percent of the rated capacity of both PRVs, downstream of the PRV station. Applications with less leakage may experience relief valve popping. Be particularly careful of this when the valve station connects to the load through a single soft-seated valve with tight shutoff. Solutions may include provision of an additional length of pipe or removal of a section of insulation to allow condensation to occur.

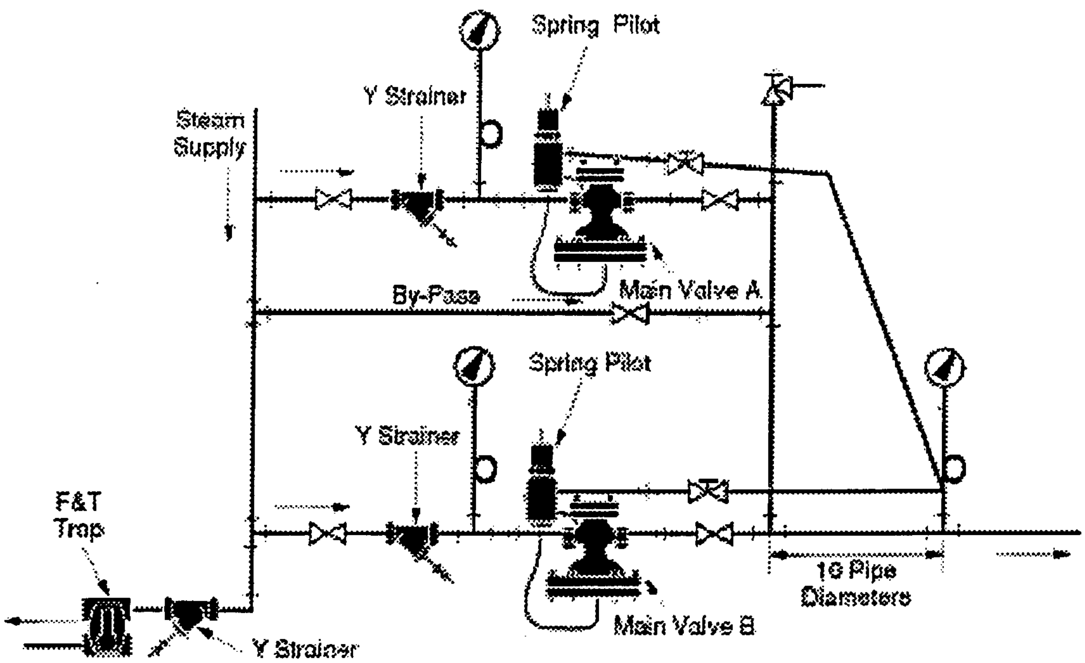
Relief Valve Size: Size the relief valve for the steam capacity of the full port (FP) configuration of both valves, regardless of port size used in the application. This is required by ASME Code, in the event the seat is replaced in the field with one of different size. Use the maximum steam capacity at the selected Δ P.

Relief Valve Set Point: The relief valve must be set at least 5 psig greater than the downstream pressure at 2 percent flow when the downstream pressure is set at 35 psig or less. The relief valve must be set at least 10 psig greater than the downstream pressure at 2 percent flow when the downstream pressure is set at 36 psig or higher. If the application capacity is 51 percent to 100 percent of the cataloged capacity, add an additional 10 percent of the downstream set point pressure (2 psig minimum) to the relief valve set point pressure. The additional pressure differential will compensate for PRV capacity droop. Staged pressure reducing stations operate with a wider pressure variation due to the pressure differential required for staging. This must be taken into consideration when selecting

6. Two PRVs in Parallel

General: This application is used where the load varies widely. Different size valves in parallel, often splitting the maximum capacity 1/3 - 2/3, are used to give reasonable control across a broader portion of the range than is possible with one valve.

Parallel reduction is not normally considered when the system load is less than 5000 pounds per hour.



Equipment Required:
2 Main Valves
2 Spring Pilots
2 Corresponding Hardware Kits

See HS-900 or use ESP-SS for product selection, remembering that the desired application capacity will be split (not necessarily equally) between two separate PRV stations operating in parallel. The two stations will operate with a similar pressure drop across each valve.
(See Capacity and System Pressure Drop below.)

Capacity: Use HS-900 to determine the capacity at a given Δ P. Installing two PRV stations in parallel will widen the overall capacity range of the application. The application will operate as low as 50 percent of the smallest valves' capacity to as high as 100 percent of the combined

 PR - 10

FINAL

RS&H

SUBJECT Ft. Gordon Hospital	AEP NO
ECO-BP1	SHEET 1 OF 2
DESIGNER G.W.F.	DATE 2-14-96
CHECKER	DATE

REDUCE STEAM PRESSURE FROM 90 psig TO 60 psig

WATER PROPERTIES

Psig	SAT TEMP °F	h_g (BTU/lb)
90 (SAT)	331	1188.0
60 (SAT)	308	1181.9

AT A LOWER PRESSURE THE BOILER EXIT GAS TEMPERATURE WILL BE LOWER BECAUSE THE WATER SIDE OF THE HEAT EXCHANGING SURFACE IS OPERATING AT A LOWER TEMPERATURE.

ASSUME A CONSTANT ΔT BETWEEN THE GAS AND WATER OF 220 F°. THE EXIT GAS TEMPERATURE (EGT) of THE BOILER WILL BE 220°F HIGHER THAN THE SATURATION TEMPERATURE OF THE BOILER WATER. THEREFORE, THE EXIT GAS TEMPERATURE FOR THE SUBJECT PRESSURES ARE: FULL LOAD VALUES

PRESS (psig)	SAT TEMP (°F)	EGT (°F)
90	331	551
60	308	528

SUBMITTING THESE EGT'S TO DETAILED COMBUSTION CALCULATIONS YIELDS THE FOLLOWING RESULTS

PRESS (psig)	EFFICIENCY (%)	
90	80.0	(NEW BOILER SPEC.)
60	80.6	FY96 RENOVATION Project

RS&H

SUBJECT	Ft. GORDON HOSPITAL	AEP NO	
	ECO-BPI	SHEET	2 OF 2
DESIGNER	GWF	DATE	2-14-96
CHECKER		DATE	

ANNUAL ENERGY SAVED

FY95 Energy use = 78,011 MBTU/yr. Reduce by 20% due to Renovation Project

Savings =

$$78{,}011 * 0.8 - (78{,}011 * 0.8) * \frac{0.80}{0.806}$$

$$= \underline{464} \text{ MBTU/yr}$$

Cost Savings = 464 * 2.7 = $1250/yr.

ESTIMATED CAPITAL COST

THERE IS NO CAPITAL REQUIRED TO MAKE THIS CHANGE. ALL THAT IS REQUIRED IS TO RE-SET THE PLANT PRESSURE MASTER TO 60 psig ON THE MAIN BOILER CONTROL BOARD.

EISENHOWER ARMY MEDICAL CENTER ENERGY AUDIT
FORT GORDON
ENERGY USE DATA
Filename: ENDATA.WK4

		Electricity						Natural Gas		
FY	Month	Demand (kW)	Energy (kWh)	Cost	Avg. Cost (c/kWH)	Load Factor	Energy (MBtu)	Energy (Mcf)	Energy (MBtu)	Cost
93	Oct	3625	2,178,000	$88,100	4.04	0.83	7,434	7,469	7,701	$21,562
	Nov	3920	1,825,200	$81,000	4.44	0.64	6,229	9,131	9,414	$28,054
	Dec	3348	1,951,200	$83,500	4.28	0.80	6,659	11,745	12,109	$40,808
	Jan	3557	1,944,000	$83,300	4.28	0.75	6,635	10,457	10,781	$35,686
	Feb	3463	1,699,200	$78,300	4.61	0.67	5,799	9,157	9,441	$34,554
	Mar	3532	1,839,600	$81,200	4.41	0.72	6,279	8,442	8,704	$31,072
	Apr	3481	2,073,600	$86,000	4.15	0.82	7,077	7,877	8,121	$23,795
	May	3889	1,980,000	$84,100	4.25	0.70	6,758	5,985	6,171	$17,216
	Jun	4036	2,307,600	$95,000	4.12	0.79	7,876	5,796	5,976	$15,656
	Jul	4190	2,448,000	$97,900	4.00	0.80	8,355	3,804	3,922	$11,177
	Aug	4176	2,689,200	$103,500	3.85	0.89	9,178	4,287	4,420	$12,022
	Sep	4133	2,516,400	$100,500	3.99	0.84	8,588	3,917	4,038	$9,733
94	Oct	3985	2,088,000	$86,400	4.14	0.72	7,126	3,917	4,038	$9,733
	Nov	3917	1,969,200	$83,900	4.26	0.69	6,721	7,765	8,006	$21,535
	Dec	3402	1,731,600	$81,800	4.72	0.70	5,910	8,124	8,376	$22,531
	Jan	3301	1,868,400	$84,900	4.54	0.78	6,377	5,897	6,080	$15,868
	Feb	3524	1,677,600	$80,600	4.80	0.65	5,726	7,069	7,288	$17,929
	Mar	3564	1,940,400	$86,500	4.46	0.75	6,623	8,364	8,623	$20,955
	Apr	3877	2,095,200	$89,900	4.29	0.74	7,151	6,032	6,219	$15,050
	May	3924	2,055,600	$89,000	4.33	0.72	7,016	5,296	5,460	$13,705
	Jun	3974	2,365,200	$99,900	4.22	0.82	8,072	3,630	3,743	$9,431
	Jul	4093	2,394,000	$101,000	4.22	0.80	8,171	3,415	3,521	$8,168
	Aug	4075	2,696,400	$108,000	4.01	0.91	9,203	4,041	4,166	$9,124
	Sep	4201	2,318,400	$99,400	4.29	0.76	7,913	4,184	4,314	$10,353
95	Oct	3697	2,127,600	$90,600	4.26	0.79	7,261	5,420	5,588	$13,858
	Nov	3730	1,882,800	$85,300	4.53	0.69	6,426	6,738	6,947	$18,270
	Dec	3319	1,674,000	$80,900	4.83	0.69	5,713	8,127	8,378	$22,622
	Jan	3308	1,886,400	$85,800	4.55	0.78	6,438	9,515	9,810	$26,487
	Feb	3312	1,501,200	$76,800	5.12	0.62	5,124	8,393	8,653	$23,364
	Mar	3380	1,980,000	$87,900	4.44	0.81	6,758	7,448	7,679	$20,733
	Apr	3388	1,778,400	$83,500	4.70	0.72	6,070	6,401	6,599	$17,818
	May	3884	2,091,600	$90,300	4.32	0.74	7,139	5,818	5,998	$16,196
	Jun	3694	2,192,400	$95,900	4.37	0.82	7,483	4,567	4,709	$12,713
	Jul	4021	2,412,000	$101,200	4.20	0.82	8,232	3,903	4,024	$10,865
	Aug	4101	2,509,200	$104,000	4.14	0.84	8,564	4,171	4,300	$11,611
	Sep	4010	2,260,800	$98,100	4.34	0.78	7,716	5,165	5,325	$14,378
Totals	FY93	4190	25,452,000	$1,062,400	4.17	0.77	86,868	88,067	90,797	$281,334
	FY94	4201	25,200,000	$1,091,300	4.33	0.75	86,008	67,734	69,834	$174,382
	FY95	4101	24,296,400	$1,080,300	4.45	0.76	82,924	75,666	78,011	$208,914
	CY94	4201	25,095,600	$1,096,000	4.37	0.76	85,651	68,213	70,327	$175,334

Fy95 Summary	Use	Cost
Electricity	82,924	$1,080,300
Natural Gas	78,011	$208,914
Total	160,935	$1,289,214

COMBUSTION CALCULATIONS

INPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 11:01 AM
Firetube,90 psig, Sat,10%Excess Air, 80% Eff.

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.67
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	476
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.00
UNACCOUNTABLE LOSS (%)	1.00
ENTHALPY ADDED IN BOILER (BTU/LB)	1000

FANS

	STAT.PRES (IN.H2O)	EFFICIENCY (%)	AIR SUPPLIED (% TOT.)	TEST BLOCK FLOW (%)	TEST BLOCK STATIC (%)
PRIMARY	5.0	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	0.0	85.0		25	56

COMBUSTION CALCULATIONS

OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 11:01 AM
Firetube,90 psig, Sat,10%Excess Air, 80% Eff.

HEAT LOSSES	MBTU /HR	PERCENT
IN DRY FLUE GAS	1.42	7.37
FROM H2O IN AIR	0.04	0.19
FROM H20 IN FUEL--SENSIBLE	0.33	1.72
FROM H20 IN FUEL--LATENT	1.87	9.72
TOTAL IN WET FLUE GAS	3.66	19.00
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABLE	0.19	1.00
TOTAL	3.85	20.00

BOILER EFFICIENCY (%)	80.00
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.18
SPEC.VOL.OF WET FLUE GAS (CU.FT./LB)	24.69
AIR TO FUEL RATIO (LB AIR/LB FUEL)	18.93
COMB. AIR SPECIFIC VOL. (CU.FT/LB)	13.712
COMBUSTION AIR FLOW (LBS/HR)	15447

FLUE GAS ANALYSIS

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.53
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.11	1.98	2.26
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.83	87.34	72.09	82.21
H2O	18.90		12.31	

RP-5

COMBUSTION CALCULATIONS
OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 11:01 AM
Firetube,90 psig, Sat,10%Excess Air, 80% Eff.

FLUE GAS FLOWS

	WET	DRY
MASS (LBS/HR)	16253	14252
VOLUME (ACFM)	6687	5423
(SCFM)(70DEG.F.)	3788	3072
@ 12% CO2	5309	3492
"F" FACTOR		
(DSCF/MMBTU @12% CO2)		10884

FAN DATA

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15447	3530	3.39	16992	3883	4.47
SECONDARY	0	0	0	0	0	0
INDUCED	16253	6687	0	20316	8359	0

COMBUSTION CALCULATIONS

INPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:59 AM
Firetube,60 psig, Sat,10%Excess Air

FUEL ULTIMATE ANALYSIS

CONSTITUENT	WT.PCT.	RECEIVED	DRY & ASH FREE	ADJUSTED/ AS FIRED
CARBON	75.00	0.75	0.75	75.00
HYDROGEN	25.00	0.25	0.25	25.00
OXYGEN	0.00	0.00	0.00	0.00
NITROGEN	0.00	0.00	0.00	0.00
SULFUR	0.00	0.00	0.00	0.00
CHLORINE	0.00	0.00	0.00	0.00
WATER	0.00	0.00	0.00	0.00
INERTS	0.00	0.00	0.00	0.00
TOTAL	100.00	1.00	1.00	100.00

FUEL RATE (TONS/DAY)	9.53
TOTAL AIR ASSIGNED (%)	110
FUEL HIGHER HEATING VALUE (BTU/LB)	23896
HEAT LOSS DUE TO UNBURNED CARBON (%)	0.00
CARBON IN RESIDUE (%)	0.00
EXIT GAS TEMPERATURE (Deg. F)	453
AMBIENT DRY BULB TEMP (Deg.F)	80
HUMIDITY RATIO (LBS H2O/LB DRY AIR)	0.0132
BAROMETRIC PRESSURE (IN.Hg.)	29.92
RADIATION LOSS (%)	0.00
UNACCOUNTABLE LOSS (%)	1.00
ENTHALPY ADDED IN BOILER (BTU/LB)	993

FANS

	STAT.PRES (IN.H2O)	EFFICIENCY (%)	AIR SUPPLIED (% TOT.)	TEST BLOCK FLOW (%)	TEST BLOCK STATIC (%)
PRIMARY	5.0	82.0	100	10	20
SECONDARY	0.0	82.0	0	20	44
INDUCED DRAFT	0.0	85.0		25	56

COMBUSTION CALCULATIONS

OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:59 AM
Firetube,60 psig, Sat,10%Excess Air

HEAT LOSSES	MBTU /HR	PERCENT
IN DRY FLUE GAS	1.31	6.91
FROM H2O IN AIR	0.03	0.18
FROM H20 IN FUEL--SENSIBLE	0.31	1.61
FROM H20 IN FUEL--LATENT	1.85	9.72
TOTAL IN WET FLUE GAS	3.50	18.42
DUE TO UNBURNED CARBON	0.00	0.00
DUE TO HOT ASH	0.00	0.00
DUE TO RADIATION & UNACCOUNTABLE	0.19	1.00
TOTAL	3.69	19.42

BOILER EFFICIENCY (%)	80.58
STEAM GENERATED (LBS/HR)	15400
UNBURNED CARBON (LBS/HR)	0
LBS OF WET FLUE GAS PER LB FUEL	20.18
SPEC.VOL.OF WET FLUE GAS (CU.FT./LB)	24.08
AIR TO FUEL RATIO (LB AIR/LB FUEL)	18.93
COMB. AIR SPECIFIC VOL. (CU.FT/LB)	13.712
COMBUSTION AIR FLOW (LBS/HR)	15229

FLUE GAS ANALYSIS

	% BY VOLUME		% BY WEIGHT	
	WET	DRY	WET	DRY
CO2	8.56	10.56	13.62	15.53
SO2	0.0000	0.0000	0.0000	0.0000
O2	1.71	2.11	1.98	2.26
HCL	0.0000	0.0000	0.0000	0.0000
N2	70.83	87.34	72.09	82.21
H2O	18.90		12.31	

COMBUSTION CALCULATIONS

OUTPUT

CLIENT: C.O.E. DATE: Jun 28,1996

PLANT: Eisenhower Army Med. Ctr. TIME: 10:59 AM
Firetube,60 psig, Sat,10%Excess Air

FLUE GAS FLOWS

	WET	DRY
MASS (LBS/HR)	16023	14050
VOLUME (ACFM)	6430	5215
(SCFM)(70DEG.F.)	3734	3028
@ 12% CO2	5234	3442
"F" FACTOR (DSCF/MMBTU @12% CO2)		10884

FAN DATA

	NET			TEST BLOCK		
	LBS/HR	ACFM	BHP	LBS/HR	ACFM	BHP
PRIMARY	15229	3480	3.34	16752	3828	4.41
SECONDARY	0	0	0	0	0	0
INDUCED	16023	6430	0	20029	8038	0

COMPRESSIBLE FLOW THROUGH ORIFICES
CRANE, p. 3-24

$W = 1891\ Y\ d^2_1\ C\ (\Delta P\ \rho_1)^{0.5}$

Steam pressure, gauge	P_1	psig	60	75	100	125	135
Steam pressure, absolute	P'_1	psia	75	90	115	140	150
Steam Temperature	-	°F	308	320	338	353	358
Weight density	ρ_1	lbs/ft^3	0.17	0.20	0.26	0.31	0.33
Flow Rate	W	lbs/hr	5400	5885	6609	7257	7500
Flow Rate	-	cfs	8.76	8.04	7.16	6.52	6.31
Pipe ID	d_2	in	6.0	6.0	6.0	6.0	6.0
Pipe Area	-	ft^2	0.196	0.196	0.196	0.196	0.196
Velocity	v	ft/sec	44.6	40.9	36.4	33.2	32.1
Viscocity (p. A2)	μ	centipoise	0.015	0.015	0.015	0.015	0.015
Reynolds Number	R	-	1.29E+07	9.97E+06	7.04E+06	5.32E+06	4.82E+06
Orifice Diameter	d_1	in	3.313	3.313	3.313	3.313	3.313
Diameter Ratio (p. A20)	β	d_1/d_2	0.552	0.552	0.552	0.552	0.552
Flow Coeff. (p. A20)	C	-	0.635	0.635	0.635	0.635	0.635
Resistance Coeff.	K	-	18.5	18.5	18.5	18.5	18.5
Net Exp. Factor (A-21)	Y	-	0.99	0.99	0.99	0.99	0.99
Pressure Differential	ΔP	psi	1.00	1.00	1.00	1.00	1.00
Pressure Differential	ΔP	in w.c.	27.7	27.7	27.7	27.7	27.7
Pressure Differential	ΔP	in Hg	2.04	2.04	2.04	2.04	2.04
Pressure Ratio	$\Delta P/P'_1$	-	0.0133	0.0111	0.0087	0.0071	0.0067
Flow Rate	W	lbs/hr	5400	5885	6609	7257	7500

$W = 1891\ Y\ d^2_1\ C\ (\Delta P\ \rho_1)^{0.5}$

$R = 123.9\ d_2 v \rho_1/\mu$

RP-10

FINAL

Curve Data

	60 psig			75 psig			100 psig			125 psig			135 psig	
psig	5,400	"H_2O	psig	5,885	"H_2O	psig	6,609	"H_2O	psig	7,257	"H_2O	psig	7,500	"H_2O
0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
0.2	2,415	6	0.2	2,632	6	0.2	2,956	6	0.2	3,245	6	0.2	3,354	6
0.4	3,415	11	0.4	3,722	11	0.4	4,180	11	0.4	4,590	11	0.4	4,743	11
0.6	4,182	17	0.6	4,558	17	0.6	5,119	17	0.6	5,621	17	0.6	5,809	17
0.8	4,829	22	0.8	5,263	22	0.8	5,911	22	0.8	6,491	22	0.8	6,708	22
1.0	5,400	28	1.0	5,885	28	1.0	6,609	28	1.0	7,257	28	1.0	7,500	28
1.2	5,915	33	1.2	6,446	33	1.2	7,240	33	1.2	7,949	33	1.2	8,215	33
1.4	6,389	39	1.4	6,963	39	1.4	7,820	39	1.4	8,586	39	1.4	8,874	39
1.6	6,830	44	1.6	7,444	44	1.6	8,359	44	1.6	9,179	44	1.6	9,486	44
1.8	7,244	50	1.8	7,895	50	1.8	8,867	50	1.8	9,736	50	1.8	10,062	50
2.0	7,636	55	2.0	8,322	55	2.0	9,346	55	2.0	10,263	55	2.0	10,606	55
2.2	8,009	61	2.2	8,728	61	2.2	9,802	61	2.2	10,763	61	2.2	11,124	61
2.4	8,365	66	2.4	9,116	66	2.4	10,238	66	2.4	11,242	66	2.4	11,618	66
2.6	8,706	72	2.6	9,489	72	2.6	10,656	72	2.6	11,701	72	2.6	12,093	72
2.8	9,035	78	2.8	9,847	78	2.8	11,059	78	2.8	12,143	78	2.8	12,549	78
3.0	9,352	83	3.0	10,192	83	3.0	11,447	83	3.0	12,569	83	3.0	12.990	83
3.2	9,659	89	3.2	10,527	89	3.2	11,822	89	3.2	12,981	89	3.2	13.416	89
3.4	9,956	94	3.4	10,851	94	3.4	12,186	94	3.4	13,381	94	3.4	13,828	94
3.6	10,245	100	3.6	11,165	100	3.6	12,539	100	3.6	13,769	100	3.6	14,229	100
3.8	10,526	105	3.8	11,471	105	3.8	12,883	105	3.8	14,146	105	3.8	14,619	105
4.0	10,799	111	4.0	11,769	111	4.0	13,217	111	4.0	14,513	111	4.0	14,999	111
4.2	11,066	116	4.2	12,060	116	4.2	13,544	116	4.2	14,872	116	4.2	15,369	116
4.4	11,326	122	4.4	12,344	122	4.4	13,863	122	4.4	15,222	122	4.4	15,731	122
4.6	11,581	127	4.6	12,621	127	4.6	14,174	127	4.6	15,564	127	4.6	16,085	127
4.8	11,830	133	4.8	12,893	133	4.8	14,479	133	4.8	15,899	133	4.8	16,431	133
5.0	12,074	138	5.0	13,158	138	5.0	14,778	138	5.0	16,227	138	5.0	16,769	138
5.2	12,313	144	5.2	13,419	144	5.2	15,070	144	5.2	16,548	144	5.2	17,102	144
5.4	12,547	149	5.4	13,675	149	5.4	15,357	149	5.4	16,863	149	5.4	17,427	149
5.6	12,778	155	5.6	13,926	155	5.6	15,639	155	5.6	17,173	155	5.6	17,747	155
5.8	13,004	161	5.8	14,172	161	5.8	15,916	161	5.8	17,477	161	5.8	18,061	161
6.0	13,226	166	6.0	14,414	166	6.0	16,188	166	6.0	17,775	166	6.0	18,370	166
6.2	13,445	172	6.2	14,653	172	6.2	16,456	172	6.2	18,069	172	6.2	18,674	172
6.4	13,660	177	6.4	14,887	177	6.4	16,719	177	6.4	18,358	177	6.4	18,972	177
6.6	13,872	183	6.6	15,118	183	6.6	16,978	183	6.6	18,643	183	6.6	19,267	183
6.8	14,080	188	6.8	15,345	188	6.8	17,233	188	6.8	18,923	188	6.8	19,556	188
7.0	14,286	194	7.0	15,569	194	7.0	17,485	194	7.0	19,200	194	7.0	19,842	194
7.2	14,488	199	7.2	15,790	199	7.2	17,733	199	7.2	19,472	199	7.2	20,123	199
7.4	14,688	205	7.4	16,008	205	7.4	17,978	205	7.4	19,740	205	7.4	20,401	205
7.6	14,885	210	7.6	16,223	210	7.6	18,219	210	7.6	20,005	210	7.6	20,675	210
7.8	15,080	216	7.8	16,435	216	7.8	18,457	216	7.8	20,267	216	7.8	20,945	216
8.0	15,272	221	8.0	16,644	221	8.0	18,692	221	8.0	20,525	221	8.0	21,212	221
8.2	15,462	227	8.2	16,851	227	8.2	18,925	227	8.2	20,780	227	8.2	21,475	227
8.4	15,649	233	8.4	17,055	233	8.4	19,154	233	8.4	21,032	233	8.4	21,736	233
8.6	15,834	238	8.6	17,257	238	8.6	19,381	238	8.6	21,281	238	8.6	21,993	238
8.8	16,018	244	8.8	17,457	244	8.8	19,605	244	8.8	21,527	244	8.8	22,247	244
9.0	16,199	249	9.0	17,654	249	9.0	19,826	249	9.0	21,770	249	9.0	22,499	249
9.2	16,378	255	9.2	17,849	255	9.2	20,045	255	9.2	22,011	255	9.2	22,747	255
9.4	16,555	260	9.4	18,042	260	9.4	20,262	260	9.4	22,249	260	9.4	22,993	260
9.6	16,730	266	9.6	18,233	266	9.6	20,476	266	9.6	22,484	266	9.6	23,236	266
9.8	16,903	271	9.8	18,422	271	9.8	20,689	271	9.8	22,717	271	9.8	23,477	271
10.0	17,075	277	10.0	18,609	277	10.0	20,899	277	10.0	22,948	277	10.0	23,716	277
10.2	17,245	282	10.2	18,794	282	10.2	21,107	282	10.2	23,176	282	10.2	23,952	282
10.4	17,413	288	10.4	18,977	288	10.4	21,313	288	10.4	23,402	288	10.4	24,185	288
10.6	17,580	293	10.6	19,159	293	10.6	21,517	293	10.6	23,626	293	10.6	24,417	293
10.8	17,745	299	10.8	19,339	299	10.8	21,719	299	10.8	23,848	299	10.8	24,646	299
11.0	17,908	304	11.0	19,517	304	11.0	21,919	304	11.0	24,068	304	11.0	24,873	304
11.2	18,070	310	11.2	19,694	310	11.2	22,117	310	11.2	24,286	310	11.2	25,098	310
11.4	18,231	316	11.4	19,869	316	11.4	22,314	316	11.4	24,502	316	11.4	25,321	316
11.6	18,390	321	11.6	20,042	321	11.6	22,509	321	11.6	24,716	321	11.6	25,542	321
11.8	18,548	327	11.8	20,214	327	11.8	22,702	327	11.8	24,928	327	11.8	25,762	327
12.0	18,704	332	12.0	20,385	332	12.0	22,893	332	12.0	25,138	332	12.0	25,979	332

RP-11

FINAL

Inlet		
flow	#/hr	1,000
Pressure	psia	75
Temperature	deg F	307.6
Sat Temp	deg F	307.6
Enthalpy	Btu/#	1,182
Entropy	BTU/#F	1.6258
Sp. Vol	ft^3/lb	5.8395
Outlet		
Pressure	psia	1
Entropy	BTU/#F)	1.6258
H@ s=c	Btu/#	908
Sp. Vol	ft^3/lb	
turb. eff	%	85%
gen eff	%	95%
H (actual)	Btu/#	949
h2-h1	Btu/#	232.69
gen-out	kw	64.77

Superheated Steam f(P,S)

	10	100	450	2000
	1	0	0	0
SG	1.9847	0	0	0
SG-S	0.359	0	0	0
	1	0	0	0
X	0	0	0	0
X4	0	0	0	0
SO	2.1501	2.3336	1.7067	
AO	1223.3	1357.2	1400	-4.7169
A1	82.096	1144.6	742.24	561.46
A2	895.12	993.78	-3491.4	
A3	547.7	1424.1	34808	
A4	0	3431.8	0	
A5	-0.5243	-0.7078	-0.0809	
HI	986.62	1401.3	1298.6	908.08
	0	0	0	908.08
	0	0	0	908.08

Superheated Steam (P,T)					
Enthalpy		SP.vol		Entropy	
T	426.2649	T	426.2649	T	426.2649
P	5.103464	P	5.103464	P	5.103464
B_1	17.27528	Z	-0.00043	Beta	0.753776
B_0	-15.3853	B	-17.4165	S1	1.999575
B_2	82.546	V	5.839522		
B_3	381.1245				
B_4	93.04511				
B_5	297.8664				
F_0	-68.0683				
B_6	-46511.2				
B_7	32466.45				
B_8	2.62968				
F	1199.475				
B_9	-0.0011				

Saturated Steam Temperature (P)

P	75
X	1.875061
X^4	12.36123
T_{SL}	301.7976
T_{SL}	307.5929

Inlet		
flow	#/hr	1,000
Pressure	psia	90
Temperature	deg F	320.3
Sat Temp	deg F	320.3
Enthalpy	Btu/#	1,185
Entropy	BTU/#F	1.6110
Sp. Vol	ft^3/lb	4.9165
Outlet		
Pressure	psia	1
Entropy	BTU/#F)	1.6110
H@ s=c	Btu/#	900
Sp. Vol	ft^3/lb	
turb. eff	%	85%
gen eff	%	95%
H (actual)	Btu/#	943
h2-h1	Btu/#	242.61
gen-out	kw	67.53

Superheated Steam f(P,S)

	10	100	450	2000
	1	0	0	0
SG	1.9847	0	0	0
SG-S	0.359	0	0	0
	1	0	0	0
X	0	0	0	0
X4	0	0	0	0
SO	2.1501	2.3336	1.7067	
AO	1223.3	1357.2	1400	-4.7169
A1	82.096	1144.6	742.24	561.46
A2	895.12	993.78	-3491.4	
A3	547.7	1424.1	34808	
A4	0	3431.8	0	
A5	-0.5243	-0.7078	-0.0809	
HI	986.62	1401.3	1298.6	899.81
	0	0	0	899.81
	0	0	0	899.81

Superheated Steam (P,T)					
Enthalpy		SP.vol		Entropy	
T	433.305	T	433.305	T	433.305
P	6.124157	P	6.124157	P	6.124157
B_1	16.44242	Z	-0.00047	Beta	0.84041
B_0	-14.5524	B	-16.6301	S1	1.986943
B_2	82.546	V	4.916453		
B_3	374.9322				
B_4	94.58183				
B_5	293.0268				
F_0	-63.6094				
B_6	-42653.2				
B_7	29510.18				
B_8	2.636794				
F	1205.251				
B_9	-0.00145				

Saturated Steam Temperature (P)

P	90
X	1.954242
X^4	14.58524
T_{SL}	313.3134
T_{SL}	320.2651

Inlet		
flow	#/hr	1,000
Pressure	psia	115
Temperature	deg F	338.1
Sat Temp	deg F	338.1
Enthalpy	Btu/#	1,190
Entropy	BTU/#F	1.5911
Sp. Vol	ft^3/lb	3.8981
Outlet		
Pressure	psia	1
Entropy	BTU/#F)	1.5911
H@ s=c	Btu/#	889
Sp. Vol	ft^3/lb	
turb. eff	%	85%
gen eff	%	95%
H (actual)	Btu/#	934
h2-h1	Btu/#	255.86
gen-out	kw	71.22

Superheated Steam f(P,S)

	10	100	450	2000
	1	0	0	0
SG	1.9847	0	0	0
SG-S	0.359	0	0	0
	1	0	0	0
X	0	0	0	0
X4	0	0	0	0
SO	2.1501	2.3336	1.7067	
AO	1223.3	1357.2	1400	-4.7169
A1	82.096	1144.6	742.24	561.46
A2	895.12	993.78	-3491.4	
A3	547.7	1424.1	34808	
A4	0	3431.8	0	
A5	-0.5243	-0.7078	-0.0809	
HI	986.62	1401.3	1298.6	888.62
	0	0	0	888.62
	0	0	0	888.62

Superheated Steam (P,T)					
Enthalpy		SP.vol		Entropy	
T	443.1931	T	443.1931	T	443.1931
P	7.825312	P	7.825312	P	7.825312
B_1	15.38726	Z	-0.00054	Beta	0.973507
B_0	-13.4973	B	-15.6368	S1	1.97023
B_2	82.546	V	3.898066		
B_3	366.5671				
B_4	96.74019				
B_5	286.4891				
F_0	-58.0593				
B_6	-37927.8				
B_7	25900.21				
B_8	2.646593				
F	1213.382				
B_9	-0.0021				

Saturated Steam Temperature (P)

P	115
X	2.060697
X^4	18.03254
T_{SL}	329.2713
T_{SL}	338.0636

Inlet		
flow	#/hr	1,000
Pressure	psia	140
Temperature	deg F	353.0
Sat Temp	deg F	353.0
Enthalpy	Btu/#	1,193
Entropy	BTU/#F	1.5749
Sp. Vol	ft^3/lb	3.2330
Outlet		
Pressure	psia	1
Entropy	BTU/#F)	1.5749
H@ s=c	Btu/#	880
Sp. Vol	ft^3/lb	
turb. eff	%	85%
gen eff	%	95%
H (actual)	Btu/#	927
h2-h1	Btu/#	266.39
gen-out	kw	74.15

Superheated Steam f(P,S)

	10	100	450	2000
	1	0	0	0
SG	1.9847	0	0	0
SG-S	0.359	0	0	0
	1	0	0	0
X	0	0	0	0
X4	0	0	0	0
SO	2.1501	2.3336	1.7067	
AO	1223.3	1357.2	1400	-4.7169
A1	82.096	1144.6	742.24	561.46
A2	895.12	993.78	-3491.4	
A3	547.7	1424.1	34808	
A4	0	3431.8	0	
A5	-0.5243	-0.7078	-0.0809	
HI	986.62	1401.3	1298.6	879.55
	0	0	0	879.55
	0	0	0	879.55

Superheated Steam (P,T)					
Enthalpy		SP.vol		Entropy	
T	451.5015	T	451.5015	T	451.5015
P	9.526467	P	9.526467	P	9.526467
B_1	14.59089	Z	-0.00059	Beta	1.096184
B_0	-12.7009	B	-14.89	S1	1.95705
B_2	82.546	V	3.232981		
B_3	359.8216				
B_4	98.55375				
B_5	281.2172				
F_0	-53.9479				
B_6	-34486.9				
B_7	23280.31				
B_8	2.654659				
F	1220.23				
B_9	-0.00283				

Saturated Steam Temperature (P)

P	140
X	2.146128
X^4	21.21398
T_{SL}	342.481
T_{SL}	353.0187

RP-12

FINAL

RS&H

SUBJECT

DESIGNER

CHECKER

AEP NO

SHEET OF

DATE 11/20/96

DATE

Steam Chart Flow Calibration

Time: 10:05 am
11/20/96

Pressure - 100 psig

Current Readings (ma)	Chart Readings[(1)] Value	Steam Flow (lbs/hr)
9.78	35	6300
10.40	37	6660
10.24	36	6480
9.2	30	5400
8.25	25	4500
7.40	20	3600
9.10	30	5400

Transducer: Signature Flow Transmitter
Model # 2408
33B421 111-201-100
Bristol Babcock Inc.
Waterbury, CN

$\frac{ma}{4-20}$

CAL	0-200	" H_2O
LRL	120	" H_2O
URL	720	" H_2O

(1) Conversion is 180 lbs/hr per division

FINAL

Eisenhower Army Medical Center
Fort Gordon
Augusta, GA
Steam Flow Chart Calibration

Filename: STMGF.XLS

Transducer Readings			Calc'd	Chart Recorder Readings		
Current	Diff. Press.		Flow	Value	Flow (1)	
(ma)	("H_2O)	(psig)	(lbs/hr)	(Divisions)	(lbs/hr)	Diff.
7.40	9.03	0.33	3774	20	3600	-4.6%
8.25	14.11	0.51	4717	25	4500	-4.6%
9.10	20.32	0.73	5661	30	5400	-4.6%
9.20	21.13	0.76	5772	30	5400	-6.4%
9.78	26.10	0.94	6416	35	6300	-1.8%
10.24	30.42	1.10	6926	36	6480	-6.4%
10.40	32.00	1.16	7104	37	6660	-6.2%

(1) Conversion is 180 lbs/hr per division

SF-2

FINAL

RS&H

Telephone Call Confirmation

Project Number ____________

(860) 945-2200

Local ____ L.D. ✓ Placed ✓ Rec'd ____ Date 12/4/96

Conversed with John Murphy Of Bristol Babcock

Regarding Signature Flow Transmitter

Ft Gordon - H&C Plant

Transducer: Signature Flow Transmitter

Model # 2408 33B421 111-201-100

CR 0-200 "H_2O

LRL 120 "H_2O

URL 720 "H_2O

This is a Range #4 transmitter. Must be calibrated between 120 & 720 "H_2O. The "33B" means the $\sqrt{DP}$ ∫ to flow. Therefore 25% of full range yields 50% signal or 12 ma.

Distribution:

SF-3 FINAL

ECO BP9 Check Boiler Water Chemistry

BOILER SYSTEM WATER ANALYSIS PROGRAM

FORT GORDON BLDG 310 BOILER 1

Sample Number . . . . LSGORDBW
Date Sampled 04/10/95
Date Received 04/17/95
Date Analyzed 04/21/95
Date Report Issued . 04/28/95

Boiler Water Analysis Report

Test Description	P&A	Plant	Control
Specific Sx Description	Sample not full.		
Total Hardness, ppm $CaCO_3$	<2		
Filt Ortho Phos, ppm PO_4	12	50	30 - 60
Polymer, ppm			5 - 10
Sulfite, ppm Na_2SO_3	9	45	20 - 40
P Alkalinity, ppm $CaCO_3$	220		
M Alkalinity, ppm $CaCO_3$	-		
Causticity, ppm OH^-	77	80	20 - 200
pH	12.0		
Neut Conductivity, mmhos	1490	1700	
Total Diss Solids, ppm	1050	1190	3000 - 3500

Specific Installation Information

Building Name..................... Hospital Boiler Plant
Address............................. Augusta, GA 30905
Phone................................. (736) 791-6093

Pretreatment .... Sodium Cycle Softener

Feedwater Temp (F)................................ 220
Feedwater Deoxygenation Methods
Mechanical.......................................
Oxygen Scavenger.................... Sodium Sulfite

Boiler Type.................................. Water Tube
Steam Gauge Pressure (PSIG)......................... 75
Boiler Horsepower.................................. 201
Boiler Output (PPH)...............................6,935

Boiler Treatment
pH Control........................... Caustic Soda
Phosphate................. Sodium Hexametaphosphate
Dispersant........................ Betz Entec 717

Condensate pH Control............. Neutralizing Amines

Comments

REMARKS AND RECOMMENDATIONS REFLECT CONDITIONS AT TIME OF SAMPLING AND MAY NOT APPLY TO CURRENT CONDITIONS.

REMARKS:

1. Test agreement is mixed. Good agreement can be seen for causticity. Sulfite difference is as expected due to its degradation over time. Conductivity/TDS shows a moderate discrepancy while that of phosphate is large and consistent with our last report for this boiler.
2. Results show that phosphate is underdosed. Sulfite is high based on the plant's result but only slightly. Causticity is within range. Blowdown continues to be excessive as noted in last report.

RECOMMENDATIONS:
Recommendations are the same ones made for the last report:

1. Reduce blowdown to allow TDS to rise into range. Treatment levels will rise as a result of reducing blowdown when chemicals are fed at a constant rate.
2. Increase dosage of phosphate and review phosphate testing procedures. Make sure sample is properly filtered.
3. Calibrate your conductivity meter.

REPORT PREPARED BY: J. Tiangco

WC-1

BOILER SYSTEM WATER ANALYSIS PROGRAM

FORT GORDON BLDG 310 BOILER 1

Sample Number . . . . RSGORDBW
Date Sampled 06/08/95
Date Received 06/19/95
Date Analyzed 06/27/95
Date Report Issued . 07/07/95

Boiler Water Analysis Report

Test Description	P&A	Plant	Control
Specific Sx Description	Sample not full.		
Total Hardness, ppm $CaCO_3$	<2		
Filt Ortho Phos, ppm PO_4	50	50	30 - 60
Polymer, ppm			5 - 10
Sulfite, ppm Na_2SO_3	4	30	20 - 40
P Alkalinity, ppm $CaCO_3$	520		
M Alkalinity, ppm $CaCO_3$			
Causticity, ppm OH^-	160	126	20 - 200
pH	11.9		
Neut Conductivity, mmhos	2410	2600	
Total Diss Solids, ppm	1700	1820	3000 - 3500

Specific Installation Information

Building Name..................... Hospital Boiler Plant
Address.............................. Augusta, GA 30905
Phone.................................. (736) 791-6093

Pretreatment .... Sodium Cycle Softener

Feedwater Temp (F)................................ 220
Feedwater Deoxygenation Methods
Mechanical...
Oxygen Scavenger.................... Sodium Sulfite

Boiler Type.................................. Water Tube
Steam Gauge Pressure (PSIG)......................... 75
Boiler Horsepower.................................. 201
Boiler Output (PPH)..............................6,935

Boiler Treatment
pH Control.............................. Caustic Soda
Phosphate................. Sodium Hexametaphosphate
Dispersant......................... Betz Entec 717

Condensate pH Control............. Neutralizing Amines

Comments

REMARKS AND RECOMMENDATIONS REFLECT CONDITIONS AT TIME OF SAMPLING AND MAY NOT APPLY TO CURRENT CONDITIONS.

REMARKS:
1. Test agreement is good showing only minor discrepanies. Sulfite difference is expected due to its degradation over time.
2. Results show good control of treatment levels. Blowdown is excessive based on low TDS.

RECOMMENDATIONS:
1. Reduce blowdown to allow TDS to rise into range. This includes bottom blowdown. The low boiler loads (typically encountered during the warmer months) require very little blowdown. Expect treatment levels to rise as TDS rises when chemicals are fed at a constant rate. Adjust treatment feedrates accordingly to keep dosages within their respective control ranges.

REPORT PREPARED BY: J. Tiangco & D.J. Robinette

WC-2

BETZ Entec

Horsham, Pennsylvania 19044-0998

WATER ANALYSIS REPORT

FOR:
[illegible]nson Control World Services
[illegible]pital Plant
WAREHOUSE D-11
FT GORDON GA 30905

ACCOUNT NO: 40771 01
ALPHA: A35
Region: 107
****

SYSTEM: Boiler
LOCATION: BOILER

DATE SAMPLED: 10/12/95
DATE RECEIVED: 10/20/95
DATE ANALYZED: 11/01/95
SAMPLED BY: E. WOODLIEF
SERVICED BY: E. WOODLIEF

SAMPLING POINT

LAB REFERENCE NO.:	F1023039	F1023040	F1023041	F1023042	F1023043
DETERMINATION	CITY RAW WTR MU 1	SOFT MU 2	BLR FDWTR 6	BLR 2 7	COND 8
Ammonia as N,ppm					
Carbon Dioxide as CO2,ppm					
Total Hardness as CaCO3,ppm	35	33	3.5	36	2.4
Calcium as CaCO3,ppm	32	29	2.9	33	2.0
Magnesium as CaCO3,ppm	3.0	4.0	0.60	3.0	0.40
Phenolphthalein Alkalinity as CaCO3, ppm	0	0	0	947	9.0
Methyl Orange Alkalinity as CaCO3, ppm	15.0	14.0	20	1020	33
Sulfate as SO4,ppm	14.8	14.2	2.8	43	0.60
Ch[illegible]s Cl,ppm	6.7	6.7	7.5	62	10.7
Silica as SiO2,ppm	5.7	5.3	3.5	32	4.4
Total Phosphate as PO4,ppm	< 0.40	< 0.40	6.2	22	13.5
Total Inorganic Phosphate as PO4, ppm	< 0.20	< 0.20	6.2	22	13.5
Orthophosphate as PO4,ppm	< 0.20	< 0.20	4.8	22	2.6
pH	6.6	6.7	7.9	12.1	9.5
Specific Conductance,micromhos 25C	100	95	79	4600	120
Specific Conductance, micromhos 25C (corrected)				1780	
Total Copper as Cu,ppm	< 0.050	0.011	0.048	0.45	0.077
Total Iron as Fe,ppm	< 0.050	0.031	0.28	0.66	0.79
Sodium, ppm	2.0	2.4	14.4	484	23
Nitrate, ppm				1.1	
Soluble Hardness				< 1.0	

Customer Copy

WC - 3

FINAL

BETZ ENTEC INC.

HORSHAM, PENNSYLVANIA 19044

SYSTEM REVIEW

Company: Pan Am World Services

Reported to: Mr. Bob Hampton

Address: P.O. Box 7506

Fort Gordon, Georgia 30905

Copy to: Mr. Steven T. Siple

System: Boiler Acct.: 40771-C35 Chart #: 01/02 Date:

TESTS	Raw	MU A	MU B	FW	BLR #1	BLR #2	BLR #3	310 Cond	352 FW	352 Blr	352 Cond	CONTROL LIMITS FW	Boiler	Cond
Cond.	50	[illegible]		60	OFF	2200	OFF	25	[illegible]	OFF			2000-2500	Record
Hardness		10	0	Trace								0-1		
P-Alk.					LINE		LINE		LINE				300-600	
OH-Alk						372							60-600	
Phosphate						[illegible]							30-60	
Sulfite						30							30-50	
pH				9.2		11.9		9.0						8.0-8.5

1) Water softener control has been good although the 4 unit needed to be regenerated. Please make sure that during regeneration that the indicator knob is lined up. This knob directs flow through various valves for regeneration. Failure to do so can result in short-circuiting through the softener.

Blowdown control looks great! Keep up the good work!

2) Sulfite consumption (733) ... up slightly. Continue to keep the conductivity at the upper limits to avoid the [illegible] 733 used.

Thank you for allowing Betz Entec to be of service.

Signed: James Wagner

PRODUCT	722	733	Caustic	748	717	[illegible]
INVENTORY	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]
REORDER						

BETZ ENTEC INC.

HORSHAM, PENNSYLVANIA 19044

FINAL

WC-4

MT 114 9003

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IMCOR
A Subsidiary Of
ECOLAB®
WATER CARE

Dick Harvey

SERVICE REPORT

1-800-277-8536

PAGE 1 OF 1

COMPANY NAME	ACCOUNT NUMBER	DATE	TIME IN	TIME OUT	TOTAL TIME
Fort Gordon		1 22 96			

ADDRESS	TECHNICAL SALES REPRESENTATIVE
Hospital	Dick Harvey

CITY	STATE	ZIP	COPIES TO
Augusta	Ga		

ATTENTION	TITLE	
Jack Hallis		Boiler Room Ret. Condensate

TEST RESULTS	MAKEUP RESULTS	FEEDWATER RESULTS	FEEDWATER LIMITS	B#1 RESULTS	B#1 LIMITS	RESULTS	LIMITS	Steam RESULTS	Steam LIMITS	Cond RESULTS	Cond LIMITS	Hosp RESULTS	Hosp LIMITS	RESULTS	LIMITS
P ALKALINITY		20		380				16		28		4			
M ALKALINITY		40		450				28		40		12			
OH ALKALINITY				310											
PO_4 ORTHO				30				3.7		4.5		3.5			
mmhos CONDUCTIVITY	50	270		1450				70		150		30			
OPO_4 ORGANO															
pH															
H HARDNESS	0	3								0		0			
CA CALCIUM HARDNESS															
CL CHLORIDES															
Sulfite				30	30/60										
~~PAA~~ Polymer				19											
Polymer NW															
CYCLES															

CURRENT SYSTEM DATA

SYSTEM	WATER CARE PRODUCT	PUMP SETTING	DOSAGE	INVENTORY ON HAND	DAYS

COOLING SYSTEM	1	2	3
TEMP DROP ACROSS TOWER (°F)			
CONTROLLER SETTING			
METER READING			
BOILER SYSTEM	1	2	3
BLOWDOWN SET PT			
STACK GAS TEMP °F			
FEEDWATER TEMP °F			
OPER. PRESSURE PSIG			

RECOMMENDATIONS/REMARKS

Plant Condensate
P 44
M 60
Po4 4
mmhos 320
H 0

WC-5

SERVICED BY	ACCEPTED BY
	FINAL

24303/2700/1194 COPIES TO: CUSTOMER DISTRICT MANAGER DISTRICT OFFICE TECHNICAL SALES REPRESENTATIVE

PLANT

DATE 1/22/96

TESTED BY

Catalized Sulfite | Adjunct T | Adjunct H | Max_Range For Blow Down 3000 - 3500 ppm

BOILER	SULFITE	PHOSPHATE	CAUSTIC 350-500 OH	SOLIDS	P/H
	30-46	30-60	20-200	1000-4000	7.5-8.2
#1	30	40	90	1450	
#2					
#3	30				
#4					
#5					

CHEMICALS TO BE ADDED

#1					
#2					
#3					
#4					
#5					

REMARKS:

TOWER TESTS

TEST RESULTS				CHEMICALS ADDED
TOWER	4885	M-ALK	TDS	
	8-12	75-100	500 PPM	
#1				
#2				
#3				
#4A				
#4B				
#5				
#6				

REMARKS: 4885 Test Same AS C-380 Test

TOWER CHEMICAL PUMP & BLEED OFF SETTINGS

#1 Pump ______
#1 Bleed Off ______

#2 Pump ______
#2 Bleed Off ______

#3 Pump ______
#3 Bleed Off ______

#4A Pump ______
#4A Bleed Off ______

#4B Pump ______
#4B Bleed Off ______

#5 Pump ______
#5 Bleed Off ______

#6 Pump ______
#6 Bleed Off ______

NOTE: Add 4385, 280 and 201 per schedule

WC-6

FINAL

Form 6-2858

PLANT

DATE 6/8/95

TESTED BY ИSRV

Catalized Sulfite | Adjunct T | Adjunct H | Max-Range For Blow Down 3000 - 3500 ppm

BOILER	SULFITE	PHOSPHATE	CAUSTIC	SOLIDS	P/H
	30-46	30-60	20-200	1000-4000	7.5-8.2
#1	30	50	126	2600	8-0
#2					
#3					
#4					
#5					

CHEMICALS TO BE ADDED

#1					
#2					
#3					
#4					
#5					

REMARKS:

TOWER TESTS

TEST RESULTS				CHEMICALS ADDED
TOWER	4885	M-ALK	TDS	
	8-12	75-100	500 PPM	
#1				
#2				
#3				
#4A				
#4B				
#5				
#6				

REMARKS: 4885 Test Same AS C-380 Test

TOWER CHEMICAL PUMP & BLEED OFF SETTINGS

#1 Pump____ #2 Pump____ #3 Pump____ #4A Pump____

#1 Bleed Off____ #2 Bleed Off____ #3 Bleed Off____ #4A Bleed Off____

#4BPump____ #5 Pump____ #6 Pump____

#4B Bleed Off____ #5 Bleed Off____ #6 Bleed Off____

NOTE: Add 4385, 280 and 201 per schedule

QC 13

WC-7

FINAL

Form 6-2o5a

PLANT

DATE 4/10/85

TESTED BY UES RY

Catalized Sulfite | Adjunct T | Adjunct H | Max_Range For Blow Down 3000 - 3500 ppm

BOILER	SULFITE	PHOSPHATE	CAUSTIC	SOLIDS	P/H
	30-46	30-60	20- 200	1000-4000	7.5-8.2
#1	45	~~40~~ 50	80	1400	8-0
#2					
#3					XX
#4					
#5 35	30	28	180	2400	

CHEMICALS TO BE ADDED

#1					
#2					
#3					
#4					
#5					

REMARKS:

TOWER TESTS

TEST RESULTS				CHEMICALS ADDED
TOWER	4885	M-A1K	TDS	
	8-12	75-100	500 PPM	
#1				
#2				
#3				
#4A				
#4B				
#5				
#6				

REMARKS: 4885 Test Same AS C-380 Test

TOWER CHEMICAL PUMP & BLEED OFF SETTINGS

#1 Pump______ #1 Bleed Off______

#2 Pump______ #2 Bleed Off______

#3 Pump______ #3 Bleed Off______

#4A Pump______ #4A Bleed Off______

#4B Pump______ #4B Bleed Off______

#5 Pump______ #5 Bleed Off______

#6 Pump______ #6 Bleed Off______

NOTE: Add 4385, 280 and 201 per schedule

QC 13

WC-9

FINAL

Form 6-2858

T.M.

PREMIER WATER & ENERGY TECHNOLOGY, INC.

August 19, 1996

Mr. Yagnesa Travgdo
Reynolds, Smith and Hill. Inc.
4651 Salisbury Road
Suite 400
P.O. Box 4850
Jacksonville, Florida 32201-4850

Dear Sir;

Attached is the Water Analysis per your PO # 106084. Please let me know is you need any more information or if we can help you with anything else.

Thank You.

Susan Brooks

Susan C. Brooks
Administrative Support Manager
PREMIER WATER AND ENERGY TECHNOLOGY, INC.

WC-10 FINAL

11481 Columbia Park Drive West • Jacksonville, Florida 32258-2478 • (904) 268-1152 • Fax (904) 268-6851 • (800) 741-0984

PREMIER WATER & ENERGY TECHNOLOGY, INC.™

REYNOLDS, SMITH & HILLS, INC.
Water Analysis Report

	Location	Sample Date	Conductivity	pH	PO4	SO4	Fe	
DHW	#1	8/14/96	7	6.2	0.01	0	0.298	
DHW	#2	8/14/96	4	6.05	0.01	0	0.02	
DHW	#3	8/14/96	3	5.95	0.01	0	0.004	
DHW	#4	8/14/96	4	5.95	0.01	0	0.026	
Rehwat	#5	8/14/96	3	6.85	0.01	0	0.017	
Rehid	#6	8/14/96	4	6.45	0.16	0	0.172	*
Rawwater	#7	8/14/96	104	7.05	0.14	17	0.065	*
Steam	#8	8/14/96	24	9.45	2.68	0	0.076	*

PO4 = Phosphate
SO4 = Sulfate
Fe = Iron

The samples that are marked in the far right column with an asterisk indicate sufficient differences in results to suspect the possibility of leakage. GWF

WC-11

FINAL

11481 Columbia Park Drive West • Jacksonville, Florida 32258-2478 • (904) 268-1152 • Fax (904) 268-6851 • (800) 741-0984

FT. GORDON

RESULTS OF CHEMICAL TESTS FOR WATER SAMPLES

Filename: Energy\Ft. Gordon\Boilers\Chemtest.xlw

#	SAMPLE	TEST	VALUE										MAX. LIMIT	CONTROL	REMARKS
			BETZ 7/20/90	P & A 4/28/95	PLANT 4/28/95	P & A 7/7/95	PLANT 7/7/95	PLANT 10/12/95	BETZ 11/1/95	PLANT 1/21/96	IMCOR 1/22/96	PREMIER 8/19/96			
1	Boiler Feed Water	Fe,ppm							0.28				0.1		Above limit
		Cu,ppm							0.048				0.05		Within limit
		Total Hardness, $CaCO_3$, ppm							3.5				0.3	0-1	Above limit
		H Hardness, $CaCO_3$, ppm									3				
		Calcium as $CaCO_3$, ppm							2.9						
		Magnesium as $CaCO_3$, ppm							0.6						
		P-Alkalinity $CaCO_3$, ppm							0		20				
		M-Alkalinity, $CaCO_3$, ppm							20		40				
		Sulfate as SO_4, ppm							2.8						
		Chloride as Cl, ppm							7.5						
		Silica, SiO_2, ppm							3.5						
		Total Phosphate as PO_4, ppm							6.2						
		Total Inorganic Phosphate as PO_4, ppm							6.2						
		Orthophosphate as PO_4, ppm							4.8						
		pH	9.2						7.9					8.0 - 9.5	Close
		Conductivity, Micro Siemens/cm	60						79		270				
		Sodium, ppm							14.4						
2	Boiler 1 Water	P-Alkalinity $CaCO_3$, ppm		220		520					360		700	300-600	Within limit
		M-Alkalinity, $CaCO_3$, ppm									450				
		OH-Alkanity, ppm		77	80	160	126	34		90	310			60-600	Within limit
		Conductivity, Micro Siemens/cm		1490	1700	2410	2500				1450		7000	2000-2500	Within limit
		Total Hardness, $CaCO_3$, ppm		<2		<2									
		Sulfite, Na_2SO_3, ppm		9	45	4	30	20		30	30			30-50	Within limit
		Orthophosphate as PO_4, ppm		12	50	50	50	37		40	30			30-60	Within limit
		pH		12		11.9	8	7.2						7.5 - 8.2	Above limit
		Total Diss. Solids, ppm		1050	1190	1700	1820	800		1450				1000-4000	Within limit
		Polymer, ppm									19			5 - 10	Above limit

WC-12

FINAL

#	SAMPLE	TEST	VALUE										MAX. LIMIT	CONTROL	REMARKS
			BETZ 7/20/90	P & A 4/28/95	PLANT 4/28/95	P & A 7/7/95	PLANT 7/7/95	PLANT 10/12/95	BETZ 11/1/95	PLANT 1/21/96	IMCOR 1/22/96	PREMIER 8/19/96			
3	Boiler 2 Water	Silica, SiO_2, ppm							32				150		Within limit
		Calcium as $CaCO_3$, ppm							33						
		Magnesium as $CaCO_3$, ppm							3						
		P-Alkalinity $CaCO_3$, ppm							947				700	300-600	Above limit
		M-Alkalinity, $CaCO_3$, ppm							1020						
		OH-Alkanity, ppm	372											60-600	Within limit
		Sulfate as SO_4, ppm							43						
		Chloride as Cl, ppm							62						
		Conductivity, Micro Siemens/cm	2200						1780				7000	2000-2500	Within limit
		Total Hardness, $CaCO_3$, ppm							36						
		Sulfite, Na_2SO_3, ppm	30											30-50	Within limit
		Total Phosphate as PO_4 , ppm	20						22					30-60	Within limit
		Total Inorganic Phosphate as PO_4 , ppm	20						22					30-60	Within limit
		Orthophosphate as PO_4 , ppm	20						22					30-60	Within limit
		pH	11.9						12.1					7.5 - 8.2	Beyond limit
		Fe,ppm							0.66						
		Cu,ppm							0.45						
		Sodium, ppm							484						
		Nitrate, ppm							1.1						
		Soluble Hardness							<1					<2	Within limit
4	City Raw Water MU	Silica, SiO_2, ppm							5.7						
		Calcium as $CaCO_3$, ppm							32						
		Magnesium as $CaCO_3$, ppm							3						
		P-Alkalinity $CaCO_3$, ppm							0						
		M-Alkalinity, $CaCO_3$, ppm							15						
		Sulfate as SO_4, ppm							14.8			17			
		Chloride as Cl, ppm							6.7						
		Conductivity, Micro Siemens/cm	80						100			104			
		Total Hardness, $CaCO_3$, ppm							35						
		Total Phosphate as PO_4 , ppm							<0.4						
		Total Inorganic Phosphate as PO_4 , ppm							<0.2						
		Orthophosphate as PO_4 , ppm							<0.2			0.14			
		pH							6.6			7.05			
		Fe,ppm							<0.05			0.065			
		Cu,ppm							<0.05						
		Sodium, ppm							2						

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FINAL

#	SAMPLE	TEST	VALUE BETZ 7/20/90	P & A 4/28/95	PLANT 4/28/95	P & A 7/7/95	PLANT 7/7/95	PLANT 10/12/95	BETZ 11/1/95	PLANT 1/21/96	IMCOR 1/22/96	PREMIER 8/19/96	MAX. LIMIT	CONTROL	REMARKS
5	Steam	P-Alkalinity $CaCO_3$, ppm									16				
		M-Alkalinity, $CaCO_3$, ppm									28				
		Orthophosphate as PO_4 , ppm									3.7	2.68			
		Conductivity, Micro Siemens/cm									70	24			
		pH										9.45			
		Sulfate as SO_4, ppm										0			
		Fe,ppm										0.076			
6	Condensate	Silica, SiO_2, ppm							4.4						
		Calcium as $CaCO_3$, ppm							2						
		Magnesium as $CaCO_3$, ppm							0.4						
		P-Alkalinity $CaCO_3$, ppm							9		28				
		M-Alkalinity, $CaCO_3$, ppm							33		40				
		Sulfate as SO_4, ppm							0.6						
		Chloride as Cl, ppm							10.7						
		Conductivity, Micro Siemens/cm	25						120		150				
		Total Hardness, $CaCO_3$, ppm							2.4						
		H Hardness, $CaCO_3$, ppm									0				
		Total Phosphate as PO_4 , ppm							13.5						
		Total Inorganic Phosphate as PO_4 , ppm							13.5						
		Orthophosphate as PO_4 , ppm							2.6		4.5				
		pH	9						9.5					8.0 - 8.5	Beyond limit
		Fe,ppm							0.79						
		Cu,ppm							0.077						
		Sodium, ppm							23						
7	Soft MU	Calcium as $CaCO_3$, ppm							29						
		Magnesium as $CaCO_3$, ppm							4						
		P-Alkalinity $CaCO_3$, ppm							0						
		M-Alkalinity, $CaCO_3$, ppm							14						
		Sulfate as SO_4, ppm							14.2						
		Chloride as Cl, ppm							6.7						
		Conductivity, Micro Siemens/cm	80						95		50				
		Total Hardness, $CaCO_3$, ppm	10						33						
		H Hardness, $CaCO_3$, ppm									0				
		Total Phosphate as PO_4 , ppm							<0.4						
		Total Inorganic Phosphate as PO_4 , ppm							<0.2						
		Orthophosphate as PO_4 , ppm							<0.2						
		pH							6.7						
		Fe,ppm							0.031						
		Cu,ppm							0.011						
		Sodium, ppm							2.4						

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FINAL

#	SAMPLE	TEST	VALUE										MAX. LIMIT	CONTROL	REMARKS
			BETZ 7/20/90	P & A 4/28/95	PLANT 4/28/95	P & A 7/7/95	PLANT 7/7/95	PLANT 10/12/95	BETZ 11/1/95	PLANT 1/21/96	IMCOR 1/22/96	PREMIER 8/19/96			
8	Hospital Cond. Ret.	P-Alkalinity $CaCO_3$, ppm									4				
		M-Alkalinity, $CaCO_3$, ppm									12				
		Orthophosphate as PO_4 , ppm									3.5				
		Conductivity, Micro Siemens/cm									30				
		H Hardness, $CaCO_3$, ppm									0				
9	DHW 4	Conductivity, Micro Siemens/cm										7			
		pH										6.2			
		Fe,ppm										0.298			
		Orthophosphate as PO_4 , ppm										0.01			
		Sulfate as SO_4, ppm										0			
10	DHW 3	Conductivity, Micro Siemens/cm										4			
		pH										6.05			
		Fe,ppm										0.02			
		Orthophosphate as PO_4 , ppm										0.01			
		Sulfate as SO_4, ppm										0			
11	DHW 2	Conductivity, Micro Siemens/cm										3			
		pH										5.95			
		Fe,ppm										0.004			
		Orthophosphate as PO_4 , ppm										0.01			
		Sulfate as SO_4, ppm										0			
12	DHW 1	Conductivity, Micro Siemens/cm										4			
		pH										5.95			
		Fe,ppm										0.026			
		Orthophosphate as PO_4 , ppm										0.01			
		Sulfate as SO_4, ppm										0			
13	REHEAT 1	Conductivity, Micro Siemens/cm										3			
		pH										6.85			
		Fe,ppm										0.017			
		Orthophosphate as PO_4 , ppm										0.01			
		Sulfate as SO_4, ppm										0			
14	REHEAT 2	Conductivity, Micro Siemens/cm										4			
		pH										6.45			
		Fe,ppm										0.172			
		Orthophosphate as PO_4 , ppm										0.16			
		Sulfate as SO_4, ppm										0			

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FINAL

F. SUBMITTAL COMMENTS AND RESPONSES

MOBILE DISTRICT PROJECT REVIEW COMMENTS:	DATE: 26 April 1996	Page 1 of 3
TO: Rob Callahan, CESAS-PM-MP US Army Engineer District, Savannah, GA	FROM: Anthony W. Battaglia, CESAM-EN-DM Phone: (334) 690-2618 FAX: (334) 690-2424	
PROJECT/FY: EEAP FY95 Hospital Energy Survey		
LOCATION: Eisenhower Army Medical Center, Fort Gordon, GA		
TYPE REVIEW: Interim Submittal Review		

NO.	Page/Par	COMMENT	Response to Comment
1.	General	A Hospital Renovation Project is referred to in this study. The main features of the project are described, and a model is prepared for base-case energy usage after renovation. However, there is no one place in the study where this information is consolidated. Nor is there stated a policy regarding the analysis of ECOs with respect to the existing base case or the renovated base case. Suggest a section be developed to summarize the information on the Renovation Project. Also, since it appears that the renovation project is either in progress or likely to be implemented, suggest that all ECOs whose outcome could be affected by the renovation project be analyzed against the renovated base case.	
2.	General	ECOs that have to do with components or systems that are going to be removed or revised by the Renovation Project should be deleted or revised as necessary to "fit in with" the renovated hospital.	
3.	Pg 2-4	Near the bottom of the page, in the discussion of the chilled water pumping: Is the system described a primary/secondary system?	
4.	General	Please proofread carefully for spelling, punctuation, typos, etc before prefinal submittal.	
5.	Pg 2-13 & others	Regarding removal of economizers: Please state if this includes removal of ID fans. There are other places in the report where this should also be mentioned. See page 4-11.	
6.	Pg 2-15	In the discussion of the condensate system, there is a paragraph regarding the energy in 60 psig condensate. No explanation is given for why 60 psig condensate is being discussed. Please provide.	
7.	Pg 2-16	Section 2.2: Please add a statement regarding separate metering of the hospital.	
8.	Pg 2-17	Regarding new chillers: Please include information on refrigerants to be used.	
9.	Pg 4-1	Please add that the detailed calculations, cost estimates, LCCA's can be found in the Appendices.	
10.	Table 4.1-1	Add page number references in comments column where it says, "See Text".	
11.	Table 4.1-5	ECO BP3 and ECO BP17 are both "recommended"; but they are mutually exclusive. The boilers in BP3 require attendants; in BP17 they do not. Maybe the title of the table should be changed to "Qualifying ECOs".	
12.	Pg 4-3	Please complete the ECO discussion.	
13.	Pg 4-5	Define "EGT". Isn't this the stack temperature? Discuss how it may decrease as system pressure decreases.	
14.	Pg 4-5	With regard to atomizing air for oil firing, is there an existing dedicated atomizing air compressor? If not, one should be clearly recommended.	

MOBILE DISTRICT PROJECT REVIEW COMMENTS:		DATE: 26 April 1996	Page 2 of 3
TO: Rob Callahan, CESAS-PM-MP US Army Engineer District, Savannah, GA		FROM: Anthony W. Battaglia, CESAM-EN-DM Phone: (334) 690-2618 FAX: (334) 690-2424	
PROJECT/FY: EEAP FY95 Hospital Energy Survey			
LOCATION: Eisenhower Army Medical Center, Fort Gordon, GA			
TYPE REVIEW: Interim Submittal Review			

NO.	Page/Par	COMMENT	Response to Comment
15.	General	There are several discussions, such as the one on pg 4-5, regarding oil firing (which is repeated elsewhere) and the discussion on harmonic analysis (which is excellent), which are treated as ECO analyses. Suggest these be treated as O&M recommendations and that they all be put together in a separate section of the report.	
16.	Pg 4-10	Regarding unknown losses: If they can't be found, it is not safe to assume that 75% of them can be corrected. This is not to say that losses should not be pursued and corrected; just that I don't feel justified in claiming savings for something that can't be quantified. Some more discussion or recommendations on where and how to look for these losses might be in order. If possible, measure consumption of autoclaves and humidifiers, check for leaks in domestic hot water heat exchangers.	
17.	Pg 4-19	This ECO is in conflict with the statement on page 4-51 that, "There is no need to make the O_2 an 'automatic' trimming function in the combustion control system; the boilers are not base-loaded enough to warrant that expense." One or the other should be recommended.	
18.	Pg 4-22	Having boilers that do not require constant attendance does not eliminate the need for operation and maintenance expenditures. Periodic visits will still be required. Please check on frequency and revise O&M savings.	
19.	Pg 4-23	Please check value quoted for peak demand. This page says 1,200 kW; page 3-2 says 4,200 kW.	
20.	Pg 4-25	a. In the Description you might mention that the system described is normally known as a "run-around" system. b. The discussion of the analysis needs some more detail. The statement about the outdoor temperature not going below 10 °F seems rather arbitrary until one reads the analysis in the Appendix. Please expand as needed.	
21.	Pg 4-27	This ECO would not work anyway; because these AHUs serve very large constant-volume distribution systems. The portion of the distribution system converted to VAV could never create the back pressure required to control the fan speed. All the air that was shut off from the unoccuppied areas would just be diverted to other spaces.	
22.	General	There are several references to AHUs 4A and 4B, and several to 4E and 4W, which appear to be the same two air handlers. Please pick one designation and use throughout the report.	
23.	Pg 4-31	Please add to the description of this ECO the practical method by which the outside air would be reduced.	
24.	Sec 4.3 General	These are, in general, good recommendations; but most of them need more detail. Please expand.	
25.	Pg 4-51	Provide typical cost per fixture for exit signs.	
26.	Pg 4-53	Fuel Switching: Provide more detail regarding the referenced "failure".	

MOBILE DISTRICT PROJECT REVIEW COMMENTS:		DATE: 26 April 1996	Page 3 of 3
TO: Rob Callahan, CESAS-PM-MP US Army Engineer District, Savannah, GA		FROM: Anthony W. Battaglia, CESAM-EN-DM Phone: (334) 690-2618 FAX: (334) 690-2424	
PROJECT/FY: EEAP FY95 Hospital Energy Survey			
LOCATION: Eisenhower Army Medical Center, Fort Gordon, GA			
TYPE REVIEW: Interim Submittal Review			

NO.	Page/Par	COMMENT	Response to Comment
27.	Pg 4-53	Feedwater Pumps: This could use more detail regarding proper method of setting feedwater pressure as a function of system operating pressure.	
28.	Pg 4-53	Reduce Overcooling: Are these existing or proposed settings? Please clarify.	
29.	VOL II General	Provide tabs and title pages for the appendices.	
30.	App D	Provide separators between ECOs.	
31.	Pg BP1A-1	Near the bottom of the page, in the table of pressure vs efficiency, it looks as if the 60 psig and the 90 psig are reversed.	
32.	Pg BP17-1	The efficiency used in the Annual Energy Savings calculation, 0.685, would be improved to about 0.78 by the Renovation Project.	
33.	Pg BP17-1	Regarding annual labor cost savings: see comment 18 above.	
34.	Pg HS3-1	Assumptions: Supply Air Temperature = 50 °F. Would this be the case in summer and winter? Is it because of use of terminal reheat? Please explain.	
35.	Pg HS3-2	a. In chiller COP equation, correct units "3413 BTU/kWhr" and "1 tonhr/12,000BTU" b. Discuss selection of value (0.6) for fan efficiency. The efficiency of a motor in this size range would be .8 to .85.	
36.	Pg MI4-1	The energy efficiency rate (0.9 kW/ton) might be OK for the existing chillers, but the new chillers will have a rating of about 0.7 kW/ton . see page BD-1. Please revise.	

RESPONSES TO COMMENTS - INTERIM SUBMITTAL
Anthony Battaglia (CESAM-EN-DM)

1. Will elaborate in sections 3.3 and 2.3. Will move Section 2.3 to 2.1.
2. This was done. Will expand discussions to make this more clear.
3. No, it is single loop. Will add diagram.
4. Okay
5. Yes, it does. Will add.
6. Will do. The hot water diagram will also be expanded.
7. Will do.
8. Will do.
9. Will do.
10. Will do.
11. Okay
12. Will do.
13. Will do.
14. Will check and expand.
15. Will do. Will add portions to O&M.
16. Will perform additional field investigations. Will check make-up meter and recording procedures as well as hospital condensate over flow problems. This will be used as an O&M recommendation.
17. Will re-word.
18. Will do.
19. Should be 4200 kw. Will correct.
20. Will do both (a) and (b).
21. We agree and favor ECO HS13 Use Damper Controls. This ECO captures 85 percent of the VAV savings and can be implemented to ensure savings. This can be done in the following manner. Measure total AHU air flow and air flow to the fourth floor with the fourth floor dampers and manually adjust the AHU VSD until the flow is equal to the flow with the damper open less the fourth air flow (with damper open). Record this setting and use controls to reset VSD to this position when dampers are closed. Will add the above to text.
22. Will check designations and change to be consistent.
23. This should be accomplished as part of the FY96 Renovation Project discussion. Will add.

24. Will do. See SOW 2.5. Add detail. Will remove O&M from low cost/no cost section.

25. Will do.

26. Will do. Will ask questions again to emphasize problems other than communications.

27. Will re-word and add explanations.

28. Will clarify and add table.

29. Will do.

30. Will do. Will use color paper.

31. Will fix.

32. Will correct.

33. Will do.

34. Yes - will clarify.

35. Will do. Will label efficiency values to alleviate confusion.

36. Will do.

FORT GORDON PROJECT REVIEW NOTES 24 May 96

REVIEWER: Curtis Oglesby, ATZH-DIC
PROJECT: FY 95 Hospital EEAP Study
LOCATION: Fort Gordon
TYPE REVIEW: Interim Submittal

NO.	PAGE	COMMENT
1.	page 2-3	There have been major problems with the motor on one chiller.
2.	GENERAL	If all recommended ECOs and proposed renovation projects are implemented, have we not only exhausted all energy project possibilities at this time, but have we also corrected all deficiencies?
3.	page 2-14 and 2-15	Building 2510 should be 25910.
4.	page 2-16	December 1995 should be 1994.
5.	Table 4.1.1, EL3	Why is there no power factor penalty?
6.	Table 4.1.1, EL4	Would the addition of synchronizing equipment to the 2100 kw generator provide a viable ECO? The 800 kw generator has synchronizing equipment. The savings would be a $45/kw credit for every kw below 2960 kw.

RESPONSE TO COMMENTS - INTERIM SUBMITTAL
CURTIS OGLESBY

1. Will add text on this.

2. Will identify and list separately O&M that will still be a concern after the FY96 Renovation Project and implementation of the ECOs.

3. Will fix.

4. Yes, will fix.

5. Will further investigate power factor problems. Is there additional penalty beyond small penalty charged by the utility?

6. Will examine and include in next submittal.

US ARMY ENGINEER DISTRICT, MOBILE
PO BOX 2288
Mobile, Alabama, 36628-0001

Fax Cover Sheet

DATE:	July 22, 1996	**TIME:**	11:55 AM
TO:	Rob Callahan, CESAS-PM-MP USAED, Savannah, GA	**PHONE:** **FAX:**	(912) 652-5246 (912) 652-5442
FROM:	Anthony W. Battaglia, CESAM-EN-DM USAED, Mobile, AL	**PHONE:** **FAX:**	(334) 690-2618 (334) 690-2424
RE:	FY95 EEAP Hospital Energy Survey, Ft Gordon, GA		

Number of pages including cover sheet: 1

Message

Following are the comments on the pre-final submittal for the referenced study.

Tony B.

MOBILE DISTRICT PROJECT REVIEW COMMENTS:		DATE: 22 July 1996	Page 1 of 1
TO: Rob Callahan, CESAS-PM-MP US Army Engineer District, Savannah, GA		FROM: Anthony W. Battaglia, CESAM-EN-DM Phone: (334) 690-2618 FAX: (334) 690-2424	
PROJECT/FY: EEAP FY95 Hospital Energy Survey			
LOCATION: Eisenhower Army Medical Center, Fort Gordon, GA			
TYPE REVIEW: Pre-Final Submittal Review			

NO.	Page/Par	COMMENT	Response to Comment
1.	Pg 2-3	At the top of the page there is a discussion of condenser water temperature control. It says that the temperature will be controlled to 5^0 F above the OA wet bulb temperature and that the high limit will be 75^0 F. In Augusta, GA, the summer outside design conditions are 97^0 DB and 76^0 WB. Could it be that the high limit is supposed to be 85^0 F? Please check and correct as needed.	
2.	Pg 4-7	In Table 4.1-5, the first five entries are marked with asterisks. The foot note says "fuel oil", which seems to apply to No. 9 but not to Nos 1 - 5. Please clarify.	
3.	Pg 4-7	Table 4.1-5, entry No. 12: Listing ECO MI3A in the table of qualifying ECOs is not consistent with the discussion on pages 4-48 & 4-49. Please revise one or the other as needed.	
4.	Pg 4-34	Analysis, 3rd line: Change "with" to "without".	
5.	Pg 4-35	Analysis, 3rd par, last sentence: Shouldn't "unoccupied" read "occupied"?	

CR-8

FINAL

RESPONSES TO COMMENTS - PREFINAL SUBMITTAL
Anthony Battaglia (CESAM-EN-DM)

1. The preliminary design drawings we received does indicate a condenser water return temperature high limit of 75 degrees F. This, of course, could not be achieved at the August summer design conditions of 97 degrees F DB and 76 degrees F WB. This is probably a typographical error. Will remove the high limit valve since it is incorrect and redundant.

2. The asterisks in the first five entries will be removed.

3. The ECO MI3A: Install occupancy sensors to control lighting in restrooms, qualified for funding only on circuits with three or more two-lamp fixtures. No restrooms at the hospital meet this criteria. Will add text in ECO discussion to clarify.

4. Agree, will correct.

5. Agree, will correct.